SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, AUGUST 2, 1901.

CONTENTS:

Doctorates Conferred by American Universities..... 161

A Basis of Scientific Thought: PROFESSOR CHARLES BASKERVILLE..... 165

Formative Museum Period: L. P. GRATACAP..... 168

Scientific Books:—

Publications of the Japanese Earthquake Investigation: DR. T. C. MENDENHALL. *Fürbringer on the Classification and Genealogy of Reptiles:* O. P. HAY. *Clark on Allegany County, Maryland:* GEORGE W. STOSE. 178

Scientific Journals and Articles 182

Discussion and Correspondence:—

The Larynx as a Musical Instrument: PROFESSOR E. W. SCRIPTURE..... 183

Shorter Articles:—

The Origin of Travertine Falls and Reefs: PROFESSOR J. C. BRANNER. *Pseudoscopic Vision without a Pseudoscope:* PROFESSOR R. W. WOOD. 184

The Botanist's Journey to the Denver Meeting of the A. A. A. S.:—

The Sand Hills of Nebraska; The Grassy Covering of the Great Plains; Trees of the Rydberg Cottonwood: PROFESSOR CHARLES E. BESSEY..... 185

The American Forestry Association..... 188

The American Association for the Advancement of Science..... 188

Scientific Notes and News..... 189

University and Educational News..... 192

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES.

THE following table, compiled from official sources, gives details in regard to the conferring of the degree of Doctor of Philosophy during the past academic year:

	Humanities.	Sciences.	Total for 1901.	1900.	1899.	1898.
Yale	21	18	39	26	30	34
Chicago	20	16	36	37	24	36
Johns Hopkins	11	19	30	33	38	33
Harvard	14	15	29	36	24	26
Columbia	12	13	25	21	33	22
Pennsylvania	13	12	25	9	20	24
Cornell	8	13	21	19	7	19
Virginia	4	4	8	2	2	0
Clark	0	7	7	9	5	12
New York	5	1	6	7	9	5
Wisconsin	2	3	5	5	7	5
Columbian	2	1	3	5	0	1
Michigan	3	0	3	5	4	7
Princeton	3	0	3	3	3	0
Brown	1	1	2	3	3	1
Minnesota	2	0	2	3	2	1
California	0	2	2	2	3	1
Stanford	1	1	2	2	0	2
Bryn Mawr	0	2	2	1	3	3
Vanderbilt	0	1	1	3	0	0
Nebraska	0	1	1	1	1	2
Washington	0	1	1	0	2	0
Tulane	0	0	0	1	0	0
Colorado	0	0	0	0	1	0
Kansas	0	0	0	0	1	0
Missouri	0	0	0	0	1	0
Syracuse	0	0	0	0	1	0
Total	122	131	253	233	224	234

The table shows that the degree was conferred on 253 candidates, an increase of 20

as compared with 1900, of 29 as compared with 1899, and of 19 as compared with 1898. This probably represents the largest number of degrees conferred during any year since the development of our university system. The degree was conferred in the sciences in nine more cases than in the humanities, a gain for the sciences as compared with preceding years. In 1898 there was an excess of 24 degrees in the humanities; in 1899 of six degrees in the sciences, and in 1890 of seven degrees in the humanities. There appears to be consequently a relative increase in the number of those who pursue advanced studies in science. We have in previous years called attention to the fact that the division of the subjects into sciences and humanities is somewhat artificial. Those that have been allotted to the exact and natural sciences are shown in the accompanying table. Of the 253 degrees, three were doctors of science, one each being given by Cornell, New York and Vanderbilt. In view of the rareness with which this degree is conferred and the desirability of using it for an honorary degree, it seems evident that it should no longer be used as a practical equivalent for the Ph.D. The Ph.D. degree, we are glad to note, was not given *causa honoris* by any university from which reports have been received. It will be noticed that the universities are divided into two fairly distinct classes. Seven—namely, Chicago, Columbia, Cornell, Harvard, Johns Hopkins, Pennsylvania and Yale—have almost invariably given between 20 and 40 degrees each year, whereas none of the other universities reaches an average of 10. This year, for example, the seven universities mentioned gave 205 degrees as compared with 48 degrees by the twenty other universities on the list. We may doubtless, however, expect a rapid increase in the number of degrees given by the State universities of the Middle and Western States.

Harvard and Yale have this year given as many degrees in the sciences as in the humanities, whereas in previous years the humanities have predominated, as the sciences have at Johns Hopkins and Cornell. There was a relative excess in the number of degrees in chemistry at Johns Hopkins; in physics at Cornell and Johns Hopkins; in mathematics at Yale; in zoology at Chicago; in psychology at Clark, Yale and Harvard, and in geology at Johns Hopkins and Harvard.

The number of doctorates in the sciences last year and in the three preceding years is as follows:

	1901.	1900.	1899.	1898.
Chemistry	28	26	32	27
Physics	23	15	7	11
Mathematics	18	11	13	11
Zoology	15	11	11	12
Psychology	13	9	15	18
Geology	10	5	5	6
Botany	8	12	11	11
Astronomy	5	4	2	3
Sociology	3	3	5	—
Education	2	8	5	—
Physiology	1	4	1	4
Anthropology	1	2	0	2
Paleontology	1	2	4	0
Anatomy	1	—	—	—
Bacteriology	1	1	1	0
Engineering	1	—	—	—
Mineralogy	0	0	2	0
Meteorology	0	0	1	0
Total	131	113	115	105

The names on whom the degrees were conferred and the titles of their theses are as follows:

JOHNS HOPKINS UNIVERSITY.

Robert Montgomery Bird: The Action of Ammonia and of Alcohols and Alcoholates on the Chlorides of Orthosulphobenzoic Acid.

Jay Allan Bonsteel: The Soils of St. Mary's County, Md., showing the Relationships of the Geology to the Soils.

Lyman James Briggs: On the Absorption of Water Vapor, Carbon Dioxide and certain Substances in Aqueous Solution by Finely Divided Quartz.

Benjamin Palmer Caldwell: On the State of Equilibrium of Certain Double Iodides, Cyanides, Nitrates and Sulphates in Aqueous Solution.

Victor John Chambers: A Further Investigation of the Action of Phenols and Alcohols on the Chlorides of Paranitroorthosulphobenzoic Acid.

William Chambers Coker: Observations on the Gametophyte and Embryo of Taxodium Distichum.

Winterton Conway Curtis: Life History, Normal Fission and Reproductive Organs of Planaria Maculata.

James McDowell Douglas: The Dissociation of certain Acids, Bases and Salts at different Temperatures.

Joseph Christie Whitney Frazer: I. On Relations between the Color and the Composition and Constitution of the Alkali Salts of Nitrophenols. II. Comparison of the Metasulphaminebenzoic Acids made by Different Methods.

Norman Everett Gilbert: Some Experiments upon the Relations between Ether, Matter and Electricity.

Gilbert Logan Houser: The Neurones and Supporting Elements of the Brain of a Selachian.

Norton Adams Kent: Notes on the Zeeman Effect.

George Curtis Martin: The Miocene Gastropod Fauna of Maryland.

Francis LeJau Parker, Jr.: A Study of the Preparation of Permanganic Acid by Electrolysis.

Harold Pender: On the Magnetic Effect of Electrical Convection.

Israel Euclid Rabinovitch: The Foundation of the Euclidean Geometry, as viewed from the Standpoint of Kinematics.

George Burr Richardson: A Study of the Red Beds of the Black Hills of South Dakota and Wyoming.

Ward Weaver Simmons: A Further Study of the so-called infusible Diamide of Parasulphobenzoic Acid.

Charles Carroll Schenck: Some Properties of the Electric Spark and its Spectrum.

YALE UNIVERSITY.

Katherine Jeannette Bush: Descriptions of three New Genera and sixteen New Species belonging to the Tribes Sabellides and Serpulides.

Charles Montague Cooke, Jr.: The Hawaiian Hepaticae of the Tribe Trigonantheae.

Walter Wells Davis: Researches in Cross Education.

Edgar Selah Downs: The Induced Alternating Current Discharge studied with reference to its Spectrum and especially the Ultra-Violet Spectrum.

Arthur Sullivan Gale: On a Particular Class of Algebraic Minimum Curves and Surfaces.

Laurence Ilsley Hewes: Some Properties of Path-Curves of Continuous Projective Groups.

Treat Baldwin Johnson: Researches on Amidines and Imidoesters.

J. E. Wallace Wallin: Researches in the Rhythm of Speech.

Stuart Weller: Studies of the Paleozoic Faunas of the Interior Continental Basin of North America, Two Volumes.

Joshua Larson: A Computation of the Orbit of Σ 3062.

Edwin Hoyt Lockwood: Atmospheric Stability as affected by Water Vapor.

Ishiro Miyake: Researches in Rhythmic Action.

John Treadwell Norton, Jr.: The use of Sodium Thiosulphate in Analysis.

Charles Adams Peters: Oxalic Acid and the Oxalates in Analysis.

Chauncey Brewster Rice: An Experimental Study of the Wehnelt Interrupter.

Edward Christian Schneider: The Excretion of Kynurenic Acid.

Edwin Bidwell Wilson: The Decomposition of the General Collineation in Space into three Skew Reflections.

Ruth Goulding Wood: Non-Euclidean Displacements and Symmetry Transformations.

UNIVERSITY OF CHICAGO.

Charles Joseph Bushnell: The Development of the Corporation in England in Relation to the Sentiment of Antagonism.

John Gaylord Coulter: A Contribution to the Life History of Sium.

Elliot Rowland Downing: The Spermatogenesis in Hydra.

Minnie Marie Enteman: Coloration of Polistes (the Common Paper Wasp).

William Findlay: The Sylow Subgroups of the Symmetric Group on K Letters.

John Morris Gillette: The Culture Agencies of a Typical Manufacturing Group, South Chicago.

Ralph Stayner Lillie: Excretory Organs of Arenicola Cristata.

Anne Moore: The Effect of Electrolytes on Rigor Mortis.

Virgil Everett McCaskill: The Metamerism of Hirudo Medicinalis.

Ralph Harper McKee: The Isourea Ethers.

James Bertram Overton: Parthogenesis in Thalictrum purpurascens.

John McClellan Prather: The Skeleton of Salaux Microdon.

Fritz Reichmann: Capacities at Small Distances.

Samuel Bower Sinclair: The Possibility of a Science of Education.

Ernest Brown Skinner: On Ternary Monomial Substitution—Groups of Finite Order with Determinant ± 1.

Helen Bradford Thompson: Psychological Norms.

HARVARD UNIVERSITY.

Charles Hamlin Ayres, Jr.: Measurements of the Internal Resistance of Galvanic Cells.

Maurice Alpheus Bigelow: The Early Development of Lepas, A Study of Cell-Lineage and Germ-Layers.

Charles William McGowan Black: The Parametric Representation of the Neighborhood of a Singular Point of an Analytic Surface.

George Ashley Campbell: On Loaded Lines in Telephonic Transmisson.

Clarence Augustus Chant: The 'Skin'-effect in Electric Oscillators; with a Method of determining Wave-Lengths.

Thomas Harvey Haines: The Temporal Relations of Mental Processes: An Experimental Study of Objective and Subjective Simultaneity.

Robert William Hall: The Development of the Mesonephros and the Müllerian Ducts in the Amphibia.

Charles Nelson Haskins: On the Invariants of Quadratic Differential Forms.

George William Heimrod: The Silver Voltameter.

Edwin Bissell Holt: The Motor Element in Vision.

Ernest Howe: The Pre-Cambrian Intrusive Rocks of the Animas Canyon, Colorado.

Benjamin Shores Merigold: A Revision of the Atomic Weight of Uranium.

Raymond Herbert Stetson: Rhythm and Rhyme.

Reuben Myron Strong: The Development of Color in the Definitive Feather.

Alfred William Gunning Wilson: Physical Geology of Central Ontario.

COLUMBIA UNIVERSITY.

Grace Andrews: The Primitive Double Minimal Surface of the Seventh Class and its Conjugate.

Frederick Mark Becket: Electrolysis of Fused Salts.

Walter Richard Crane: Investigations on Magnetic Fluids with reference to Magnetic Ore Concentration.

Bergen Davis: On a Newly Discovered Phenomenon Produced by Stationary Sound Waves.

Alfred Newton Richards: A Chemical Study of Yellow Elastic Connective Tissue.

Arthur Cleveland Hall: Civilization and Crime.

Edward Frank Kern: The Quantitative Determination and Separation of Uranium.

Alfred [Louis Kroeber: Decorative Symbolism of the Arapahoe.

George W. A. Lucky]: The Professional Training of Secondary Teachers in the United States.

Joseph Warren Miller, Jr.: Elastic Properties of Helical Springs.

Herbert Raymond Moody: Reaction at the Temperature of the Electric Arc.

Francis Bertody Sumner: Kupfer's Vesicle and its Relation to Gastrulation and Concrescence.

Clark Wissler: The Correlation of Mental and Physical Tests.

CORNELL UNIVERSITY.

William Suddards Franklin: Poynting's Theorem.

Ernest Blaker: A Spectrophotometric Comparison of the Relative Intensity of Light from Carbon at Different Temperatures.

Judson Freeman Clark: On the Toxic Action of Certain Salts of Mercury and Copper.

Benton Dales: Contributions to the Chemistry of the Rare Earths of the Yttrium Group.

Margaret Clay Ferguson: The Development of the Pollen Tube and the Division of the Generative Nucleus in Certain Species of Pines.

William Benjamin Fite: On Metabelian Groups.

Henry Waldo Kuhn: On Imprimitive Substitution Groups.

Charles Philo Matthews: On Certain Improved Photometric Apparatus and Results therewith obtained.

Welton Marks Munson: The Horticultural Status of the Genus Vaccinium.

Rolla Roy Ramsey: The Effect of Gravity and Pressure on Electrolysis.

John Sandford Shearer: Some Effects of High Elective Tension on Dielectrics.

Carrie Ransom Squire: A Genetic Study of Rhythm.

George Walter Stewart: Distribution of Energy in the Spectrums of Acetylene.

UNIVERSITY OF PENNSYLVANIA.

Gilbert Hillhouse Boggs: I. The Separation of Vanadic Acid from Metals by means of Hydrochloric Acid Gas. II. The Occurrence of Molybdenum in the Mineral Endlichite.

Henry Shoemaker Conard: Water Lilies: a Monograph on the Genus Nymphæa.

Burton Scott Easton: Substitutions and Substitution Groups.

William Clarence Ebaugh: On the Atomic Weight of Arsenic.

Henry Brown Evans: The Right Ascensions of One Hundred and Eighty Latitude Stars.

Alice Macmichael Jefferson: Aromatic Bases as Precipitants for Rare Earth Metals.

John Raymond Murlin: The Digestive System of the Land Isopods, with special reference to the Morphology of Absorption and Secretion.

Marie Louise Nichols: The Spermatogenesis of

Oniscus asellus with especial reference to the History of the Chromatin.

Jonathan Taylor Rorer: A Definitive Determination of the Orbit of Comet 1898 χ—Brooks.

Thomas Maynard Taylor: I. The Atomic Weight of Tungsten. II. On the Ammonium Tungstates.

Caroline Burling Thompson: Zygeupolia Litoralis: A New Herteronemertean.

Roxana Hayward Vivian: The Poles of a Right Line with Respect to a Curve of Order n.

CLARK UNIVERSITY.

Clemence J. France: Psychology of Gambling.

Samuel B. Haslett: A Plan and Rationale of Sunday School Work.

James Edmund Ives: Contributions to the Study of the Induction Coil.

Herbert G. Keppel: The Cubic 3-spread Ruled with Planes in 4-fold space.

Melanchthon F. Libby: Influence of the Idea of Æsthetic Proportion on the Ethics of Shaftesbury.

Charles H. Sears: Studies in Rhythm.

John N. Van der Vries: On the Multiple Points of Twisted Curves.

UNIVERSITY OF VIRGINIA.

Dr. Wm. A. Lambeth: Geology of the Monticello Area.

C. J. Moore: On the Products of Interaction between the Aliphatic Amines with certain Metallic Salts.

Herbert R. Morgan: The Orbit of Enceladus.

L. D. Skeen: Bacterial Flora of Charlottesville Reservoir Water.

UNIVERSITY OF WISCONSIN.

Charles Kenneth Leith: Rock Cleavage.

Charlotte Elvira Pengra: On Functions connected with Special Riemann Surfaces, in Particular those for which $p = 3$, 4 and 5.

Herman Schlundt: On the Dielectric Constants of Pure Solvents.

UNIVERSITY OF CALIFORNIA.

Russell Tracy Crawford: Determination of the Constant of Refraction from Observations made with the Repsold Meridian Circle of the Lick Observatory.

Frank Elmore Ross: Differential Equations Belonging to a Ternary Linearoid Group.

BRYN MAWR COLLEGE.

Mary Bidwell Breed: The Polybasic Acids of Mesitylene.

Elizabeth Rebecca Laird: The Absorption Spectrum of Chlorine.

BROWN UNIVERSITY.

Leonard Worcester Williams: The Anatomy of the Common Squid.

COLUMBIAN UNIVERSITY.

William Mather Lamson: Iron and Steel Domes.

LELAND STANFORD JUNIOR UNIVERSITY.

John Flesher Newson: A Geologic and Topographic Section across Southern Indiana, from the Ohio River at Hanover to the Wabash River at Vincennes, with a discussion of the General Distribution and Character of the Knobstone Group in the State of Indiana.

VANDERBILT UNIVERSITY.

Warren Henry Hollinshead: Some Points in Analytical Chemistry.

UNIVERSITY OF NEBRASKA.

Wilbur Clinton Knight: The Artesian Basins, Oil Fields and Mining Districts in Wyoming.

NEW YORK UNIVERSITY.

John A. Mandel: Glycuronic or Glucoronic Acid.

WASHINGTON UNIVERSITY.

Herbert J. Webber: Spermatogenesis and Fecundation of Zamia.

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*A BASIS OF SCIENTIFIC THOUGHT.**

LÉMERY in his *Cours de Chemie* (1675) was the first to separate that branch of science termed chemistry into organic and inorganic. The latter embraced those bodies found in the mineral world and those produced by means of such substances. Berzelius, recognizing that organic bodies contained carbon, maintained that they came about through the influence of a particular force—*vis vitalis*. In 1828, however, Wöhler synthetically prepared, from strictly inorganic materials in the laboratory, urea, the eventual product of animal metabolism. This discovery was followed by the synthesis of numerous other bodies hitherto thought to be possible of preparation only through the mysterious life-force.

Although the fundamental laws underlying these divisions of chemistry are the same, yet for pedagogic convenience this classification is adhered to by many; oth-

* Read at the April meeting of the N. C. Section of the American Chemical Society.

ers even diversify at greater length and we have physical chemistry, technological, analytical, agricultural and physiological chemistry. Chemical laws prevail and are the same, it matters not how one classifies his facts.

By mathematics through ages we have sought expression, whether by definite exact numbers, equations or indeterminates. It is the language of physics, making possible the expression of the invention of means for measuring force and calculating its effect upon matter. Joule, Helmholtz, Robert Mayer and Maxwell in their refined discoveries in mechanics touched chemistry, for the explanations of the phenomena of dissociation, solution, vapor pressure, osmotic pressure, etc., as developed by Arrhenius, Van't Hoff and Nernst, and taught by Ostwald, could never have gained currency save through the invention of a mode of quantitative expression by the former *savants*. J. B. Richter over a hundred years ago said that chemistry was a branch of mathematics. In fact, recently Lord Kelvin said 'Nothing can be clearly understood until we can express it in figures.'

It has only been within the past three-tenths of the present century that the barriers between physics and chemistry have been completely removed. This came about through the necessity of applying more closely certain laws of physics for the explanation of chemical facts, as, for example, electrolytic conductivity, heat of reaction and so on, and reciprocally by conversion of chemical force into electrical energy, heat, phosphorescent light, etc., and measuring the same. Mathematics has served as the medium of quantitatively determining these changes—in short, physical chemistry.

Geology may be termed the chemistry and physics of the earth's crust, more particularly applied to the inanimate portion of the world, although full cognizance is taken of alterations of the shell by animals. Latterly geology and biology, the chemistry and physics of animal life, may be said to merge. Only recently chemistry and biology have been more firmly welded into a unit by the interesting work of Bredig and Müller von Berneck on 'Inorganic Ferments,' in which was demonstrated that certain life processes, hitherto regarded as possible only through the intervention of bacilli, could be carried out by means of an active chemical. This step is far in advance of even Büchner's enzyme fermentation. Attention has been called by the sensational press to the incomplete, but fruitful and promising, researches of Loeb and E. B. Wilson on parthenogenesis or chemical fertilization.

Cognizant of the persistent outcropping of favorable evidence for Darwin's evolution, we observe a unity of purpose in animal growth. Astronomy is the chemistry and physics of celestial bodies, and our knowledge of them is based upon observations dependent upon mathematical considerations. By the term mathematics here used of course must be meant simply a method by which the senses judge.

Accepting, therefore, the articulated relation among the various utilitarian divisions of science, we may develop our theme along the lines of those teachings of which we feel best qualified to write, namely, physics and chemistry, and regard all science as these two differently applied, either as to method of application, or class to which we would direct the application. We are perfectly aware of valid arguments that may be put forward strenuously against such a conception, yet feel that we shall be reduced to the study of a unity, as we must eventually express our knowledge of all science, qualitative and quantitative, mathematically.

Despite this unifying tendency to which we would call attention, chemists persist in discovering new elements, as argon, helium,

neon, krypton, radium, polonium, etc., and seem to have *facts* in direct opposition to our ideas. Over a century ago the same Richter noted resemblances of what chemists now term elements. Lavoisier by chemical and physical means proved the law of conservation of matter. Then Dalton ascribed weights to these elements composing matter, from which came our satisfactory atomic theory. None of these, as well as Joule's masterful proof of the conservation of energy, was possible without a medium of expression, namely mathematics, whereby the necessary comparison of weights and other measurements could be made. The triads of Döbereiner and Dumas, and Newlands' octaves foreshadowed a periodicity in atomic properties as later clearly and definitely set forth by Mendeléeff and Lothar Meyer. This periodic law, so long accepted, has had shadows cast upon its universality by the failure of scientists so far to satisfactorily arrange the new elements noted (and several old ones) in accord with it. Naturally we lend ourselves to the thought that this is due to our insufficient knowledge of these novel and striking members of the chemical family.

Prout may not have been so far wrong in conception when he asserted that all the elements were compounded of hydrogen, then known to have the lowest of all atomic weights. Stas's classical researches and redeterminations of the atomic weights and Morley's accurate proof of the mass relations of hydrogen and oxygen prevent absolutely the acceptance of the fact of the statement, but the germ of thought bears fruit. The idea is still prevalent, and Crookes has termed that initial, universal substance of which all else is composed, *protyle*. In fact, J. J. Thomson has only recently, in very wonderful researches on electric discharges in gases, been able ingeniously to demonstrate, by mathematical interpretation of the experimental results, that the atom is made up of a number of smaller bodies, which he terms *corpuscles*.

Thus we are brought almost face to face with the most ancient alchemical teachings. Within recent years, Hartley, thoroughly orthodox, has written that "one element in a group differs in its properties from another not because it consists of another kind of matter, but because the quantity of matter in an atom is different." While we are not inclined to give over-serious consideration to Fittica's recent assertion that he has actually transmuted phosphorus into arsenic under one set of conditions and into antimony under another, doubtless later transmutation will become an experimental fact; not that all our base metal will be converted into a precious one, but we shall secure more refined methods and further decompose our present elements; or the increased number of elements, yearly augmented, shall give us a more perfect periodicity, demonstrating the relationship of the elements and their unity without requiring the actual experimental proof. The speculative hylozoists may thus have foretold events.

We have other experimental evidence pointing in the direction indicated. Some of our chemistries, not so long ago, dogmatically taught that hydrogen was the lightest known gas and impossible of liquefaction; or if it could be solidified, it would be metallic in character. Dewar, Olzewsky and Wroblewsky have secured that gas as a limpid liquid by intense refrigeration in vacuum-jacketed apparatus. And but recently the first named in classical researches reduced the temperature of liquid hydrogen to within eighteen degrees of the absolute zero (— 255° C.) and obtained white, crystalline, solid hydrogen. These researches with extreme cold and Moissan working at from three to four thousand degrees give us the widest ranges of temperature. The latter has already secured many elements hitherto regarded as non-volatile in a gas-

eous condition. Like Dewar's work at the low temperatures, it appears that a refinement of skill will secure all elements in a gaseous condition. Thus all matter, that is, elemental, may exist in the three physical states.

In the domain of physics, observation of the marvelous effects of the Röntgen rays, Becquerel rays, the characteristic property of certain old and some recently discovered elements, as barium, thorium, radium and polonium, show new things undreamt of. We cannot say that these discoveries, praise-deserving and wonder-creating as they are, will give us final proof of the truth of our premise as put forth, yet they do point in that direction.

All forms of energy are interchangeable, hence we have but one force, whether it exhibit itself as heat, electrical energy, chemical force, or what not. These new rays, active and specific in their demonstration, are but altered forms of the *one* force. Why not therefore a *one matter*? Having reached that point we may con within reason Ostwald's dictum, that all is force, there is no such thing as matter. We may well conclude by repeating the query of the elder Büchner, that *aberwitzig* youth: "Is it a duty to believe things that can not be proven?"

Charles Baskerville.

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*FORMATIVE MUSEUM PERIOD.**

Scientific activity developed more slowly and was less encouraged in New York in the earlier years of this century than in its neighboring rivals Boston and Philadelphia The expression of a mercantile, or more harshly described as that of a money-making city was early acquired, and baffled or obscured the spirit of scientific research. In a measure this suggestion, applied to the miscellaneous avenues of enterprise and the accumulation of wealth, was sensibly deceptive. It would be quite impossible to stifle the incentives to the study of nature in a population of nearly one million people, and the limited consideration given to physical, chemical and geological science in the colleges, high-schools and seminaries, which aroused unfailingly increased interest in the objects of nature, led to their collection, and stimulated local societies in their study and record.

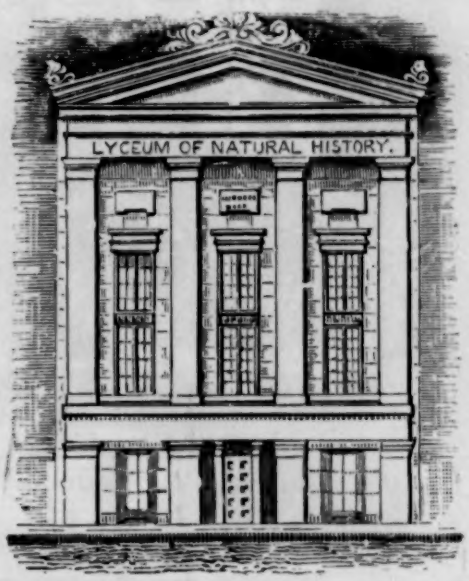
An examination of the decade immediately prior to the establishment of the American Museum of Natural History, and by implication a reference to the conditions somewhat earlier, show us the formative stages shaping public needs for its appearance and public appreciation of its value.

Philanthropic and social designs, historical research, theological learning, medical study and literary invention were significant in the more intellectual life of New York City from 1830 to the date of the foundation of the Museum in 1870; the active participation in education of three colleges, a normal school for women, two medical schools, and numerous lesser centers of learning, including the invaluable services of the Cooper Institute with two seminaries devoted to religious instruction, were distinctive evidence that New York was not oblivious to the claim of knowledge.* But science in its purer forms and especially the study of nature in its animal and vegetable life, received scant recognition in the curriculæ of instruction. Two societies, the New York Academy of Sciences, later (1876) the Lyceum of Natural History, and the Torrey Botanical Club (1870), were the guardians and shrines of the scientific life of the city, and collected in a compact coterie the separated enthusiasts

* Columbia University (King's College) dates from the last century (1754); the New York University was opened 1831; the College of the City of New York (Free Academy) in 1849; The Normal College in 1855; Union Theological Seminary in 1836; General in 1817.

in the study of nature. The Lyceum was in a precarious condition for many years, and, at least until 1836, led a shifting, and in some respects shiftless, life. In the latter year it occupied its own building at 563 Broadway, and here the elder Stillman began a series of lectures on geology, seven in all, which produced a moderate sensation in the controversies of the day. A museum was a part of the appropriate features of the society and these were increased by donations to such an extent that Mr. J. H. Redfield, a competent judge, alludes to them as 'large,' a term certainly of variable significance in the mouth of a collector. The exact nature and contents of these collections can be determined from the chapter on collections in Professor Fairchild's 'History.' In view of the many local features now introduced in the halls of the Museum and as a means of determining the advance made in the expectations and ambitions of a Museum, a glance at these collections is instructive. As early as 1817, Messrs. Torrey, Rafinesque and Knevels were made a committee 'to travel and explore the natural history and productions of the neighboring counties'; with them in this work were associated Drs. Mitchill and Townsend. Bones of a mastodon were found in Orange Co., later were added a right whale and a swordfish, from the Atlantic, while specimens of the Wallkill carp and pike, and 'white wild sheep' from the Rocky Mountains, formed the nuclei of an increasing cabinet. 'Measures for completing a catalogue of the vegetables growing within 100 miles of the city' were early instituted, a device now variously illustrated in the collections of plants, buds and insects made to-day. Minerals were added, and repeated additions of snakes and fishes, fossils, skeletons, plants and shells gave it a local reputation and naturally engendered some self-congratulation amongst its members. But when we learn that it was all accommodated in sixty-two boxes, the reader, familiar with existing needs, is recommended to realize how ideas and ideals advance.

It is not incumbent upon a historian of the American Museum to dwell upon the struggles of the Lyceum, but it would be an error in precision not to indicate the influence this and similar or affiliated movements had in determining its inception, and especially pointing out the critical relations in 1865 of the Lyceum to the projected



The Lyceum Building, No. 563 Broadway.*

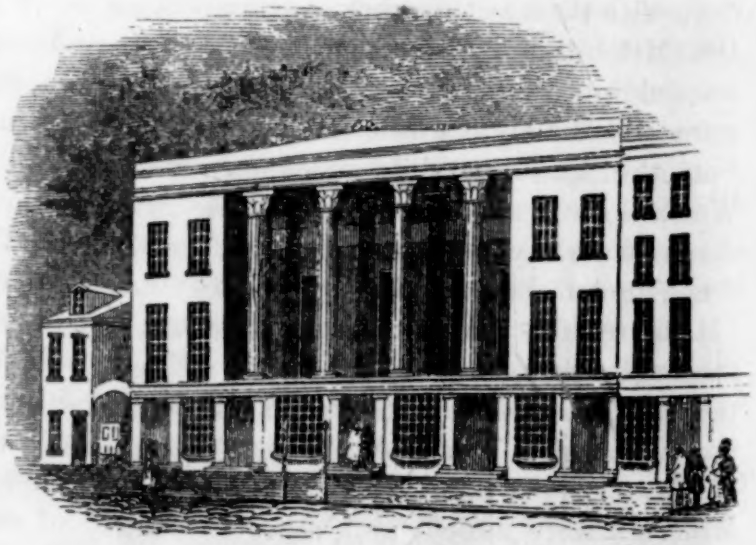
American Museum. The Lyceum increased in its membership and the papers read at its meetings by Jno. J. Audubon, De Witt Clinton, James E. Dekay, Jno. LeCompte, Samuel L. Mitchill, Jno. Torrey, Asa Gray, G. Troost, Thos. Bland, James D. Dana, Theodore Gill, Gen. L. Lawrence, Jno. H. Redfield, Temple Prime, Alexander Agassiz, W. A. Dall, J. S. Newberry, William Stimpson, Benj. N. Martin, Augustus R. Grote, while listened to by a small audience, were contributions to the development of scientific feeling in New York. Dr. Jno. C. Jay, whose collections in conchology formed the nucleus of the present cabinet

* This and other illustrations to this article are published by the courtesy of Professor H. L. Fairchild.

of shells in the American Museum, as his library was the foundation of its present

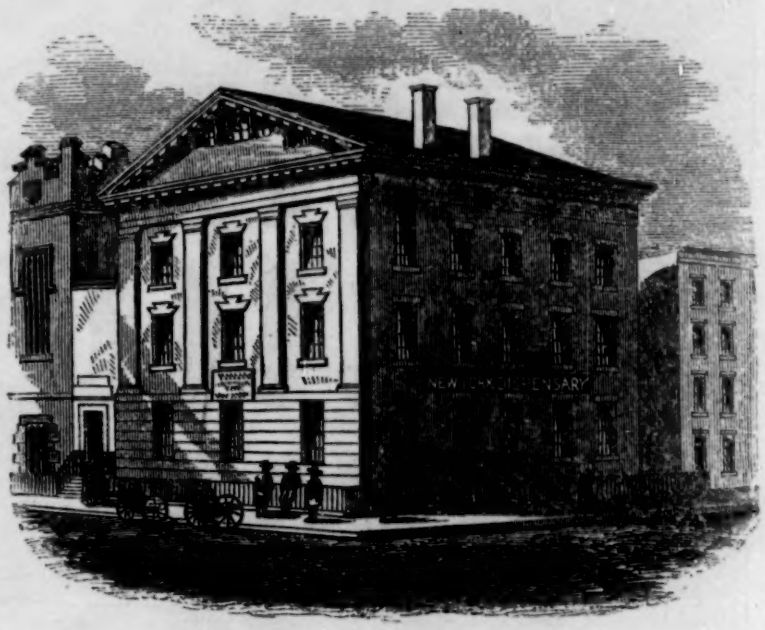
University Medical College, Fourteenth St.

library, was one of the most enthusiastic and sedulous advocates of its interests while in its financial necessities the Lyceum leaned rather too heavily on his generous sympathy. Amongst the friends and officers of the New York Lyceum from 1860 to 1869 were names afterwards identified with the opening and even the later years of the American Museum. Amongst these were William A. Haines, Robert L. Stuart, George M. Lawrence, J. Carson Brevoort, D. Jackson Steward. These gentlemen were in several instances themselves collectors and possessed libraries and cabinets of commanding interest. They became interested in 1865 in a movement to secure moneys for the furtherance of the object of the Lyceum with a possible reference to a permanent home and a hall for its collections. Quoting from Professor Fairchild's 'History of the New York Academy of Sciences' (p. 49) we learn that "the circular letter explaining the plan had affixed to it the names of the active members of that time, which were these: William A. Haines, Robert L. Stuart, George N. Lawrence, J. Carson Brevoort, H. D. Van Nostrand, Chas. A. Jay, Dr. John W. Greene, D. Jackson Steward, Charles M. Wheatley, Temple Prime, with Livingston Satterlee as Chairman." This effort was unsuccessful and the disappointed hopes of its authors were later revived and the cooperation of the more influential embodied in the creation of the American Museum of Natural History. All expectation of securing in the rehabilitation of the Lyceum a permanent museum was destroyed, when, on May 21, 1866, the Medical College building, in which the collections of the Lyceum were placed, was burned. The collections were not insured and only its valuable library escaped destruction. For years before this the Lyceum had been engaged in a despairing



Stuyvesant Institute, University Medical College.

struggle to perpetuate itself and secure an autonomous existence. It had become after the foreclosure of its own building the guest of the University, moving from the Stuyvesant Institute on Broadway to the Medical College upon the site of the present Tammany Hall. With the disappearance of its collections, and the abrupt termination of plans of its growth into a substitute for a museum, its formative relations to the American Museum ceased. Its scientific work continued, and the spirit of research it fostered helped the objects of the Museum. Such addresses as that of Dr. Barnard at its Semi-Centennial on 'The relation of science to the advancement of civilization and the expediency of a public provision for the support and encouragement of scientific inquiry' were directly stimulating to the project of a museum, at that moment ready to take place. Besides the slender and perhaps almost imperceptible influence of the Lyceum in creating a demand for a great museum, a small measure of regard can be bestowed upon the effect, on the public-spirited citizens at least, of the Brooklyn Institute, which during all these years from 1845 onward had been engaged in the study of science, in developing scientific discussion, scientific education, and in stimulating the acquirement of scientific collections. A few details of the history of this institution can hardly be disregarded in any exhaustive sketch of the scientific tendencies then surrounding or immanent in New York City. The Brooklyn Institute originated in the Brooklyn Apprentices' Library Association in 1825. It expanded rapidly. Lectures under its auspices were amongst the first public expositions of natural science near New York. In 1843 it assumed the present name and function of the Brooklyn Institute, and was really an important factor in the educational life of Brooklyn. Here Agassiz, Dana, Gray, Henry, Morse, Mitchill, Torrey, Guyot and Cooke brought the treasures of their learning and thought during the conspicuously brilliant period of its activity from 1843 to 1867. Mr. Augustus Graham endowed it, and while for some time the interests of history and the claim of religion somewhat disabled the efforts of its scientific members, collections were made, notably that of coleoptera of Harvey G. Rich, and the interests of science through its remarkable educational work advanced. It served its useful purpose in preparing the ground, in cultivating public feeling for the erection and support of a great museum. A stream of influence, not very perceptible, perhaps, but of some importance as the years drew near to 1876, emanated from the School of Mines in Columbia College (1864), where from the exertions of Professor J. S. Newberry the study of botany and zoology was more technically pursued than anywhere else in New York, and from which groups of young students



New York Dispensary, White and Centre Streets.

in geology and mineralogy were annually issuing.

Apart from the gradually educated demands amongst the studious classes, the public-spirited citizens of New York were intelligently sensitive to the reputation of the city, and when they recalled the museums of foreign cities whose collections and arrangements had challenged their admiration, they regretted that New York was yet without its own museum. In the United States it was behind other cities.

College of Physicians and Surgeons, Barclay St.

The Academy of Natural Sciences, founded in Philadelphia in 1812, possessed some collections with which were associated the names of Morton, Conrad, Nuttall, Audubon, Lucian Charles Bonaparte, Harlan, Rafinesque and others, and had created a provisional museum. Thomas Say, the distinguished conchologist, was its first curator, and through the generosity of William Maclure, the geologist, a building was opened in 1840 to the public, abundantly stored with the objects of nature, later succeeded by the structure at Nineteenth and Race avenues; at Washington, the Smithsonian Institution, embracing the aims of the National Institute, was provided with a museum, apologetic, perchance, to the taste of an exacting critic, but still a dignified place for public instruction. Boston, from the exertions of the members of its Society of Natural History, had dedicated its museum on the 2d of June, 1864, when Professors Wyman and Wm. B. Rogers, with Mayor Lincoln, gave distinction to the ceremony. In Cambridge, as early as 1860, rapid progress had been made on the new Museum of Comparative Zoology through the enthusiasm of Agassiz, whose definite relations to the creation of the American Museum of Natural History are presented later in this history. Chicago had created a museum under the auspices of Major Robert Kennicutt and later through the stimulus of Stimpson, and although it was damaged by fire in June, 1866, it still survived, and furnished, long prior to the erection of the great Field Museum, entertainment and information to the public.

There had been indeed in New York, outside of the immediate limits and influence of the Lyceum, efforts at museum installation. But they were industrial or historical or artistic and but slightingly regarded the natural sciences. It must be remembered that the impulse which finally resulted in the Museum of Natural History was twofold, and enclosed the divergent tendencies towards nature and art, for the American and Metropolitan museums were simultaneous creations.

These preliminary efforts to give a mu-

seum to New York are significant in this connection. Perhaps the first museum in which a regard for scientific arrangement was shown in New York was that described in a rare and old pamphlet printed in 1804 entitled, 'Catalogue of the Natural Productions and Curiosities which Compose the Collections of the Cabinet of Natural History, opened for Public Exhibition at No. 33 William St., New York.'* This catalogue, apparently prepared by a Delacoste, in an introduction of four pages states that "there is scarce a city or town of any importance in Europe that is not possessed of a cabinet of that kind; but in the United States of America, the variety of whose productions and their dissimilarity from those of the Old World offer ample field for the researches of the naturalist, there is scarcely a collection deserving the name, except the one in Philadelphia belonging to Wm. Peale, whose indefatigable researches and laudable exertion to promote the knowledge of natural history entitle him to the gratitude of every friend of science." This collection was exhibited as the 'Delacoste Cabinet of Natural History,' at Federal Hall and apparently at No. 80 Greenwich Street. The collections, according to the examination instituted by Mr. Avery, appear to have been gathered on the coast of Guyana in South America, presumably by this Delacoste, and were made up of 'Quadrupeds, Birds, Fishes, Insects, Reptiles and Natural Productions of Cayenne.' The information is further elicited from the pages that "this above collection, which was originally put up for a Cabinet in St. Petersburg, would be sold here, if any purchaser should offer, and in case of the contrary will be forwarded next spring to its first destination." Delacoste inaugurated the plan of subscriptions now familiar under a different form to his successors, and we find amongst his subscribers the names of leading New York people of that early day, as the Clintons, Hamiltons, Depeysters, Hosacks, Livingstons, Pringles, Seymours, Rutherfords, VanDykes, etc. Amongst these is the name of Jerome Bonaparte. Delacoste wished to make his establishment "permanent in New York, to augment his collections in proportion to the encouragement which he will receive, * * * and binds himself, if enabled by an adequate support, to travel through the whole continent of North America for the purpose of securing a skeleton of that anonymous animal called the mastodon." The subscriptions ranged from $3.00 to $1.00.

Before this in 1790 the Tammany Society 'established a museum for the purpose of collecting and preserving everything relating to the history of the country.' (Manual of the Common Council of New York, 1865, D. T. Valentine.) This museum was subsequently relinquished to Gardiner Baker, whose expenditure of time and money upon it had been considerable. After the death of Baker it was sold to W. J. Waldron, and finally was merged in the Scudder Museum, of which it formed the foundation, in Chatham Street. This embryonic effort was called the American Museum.

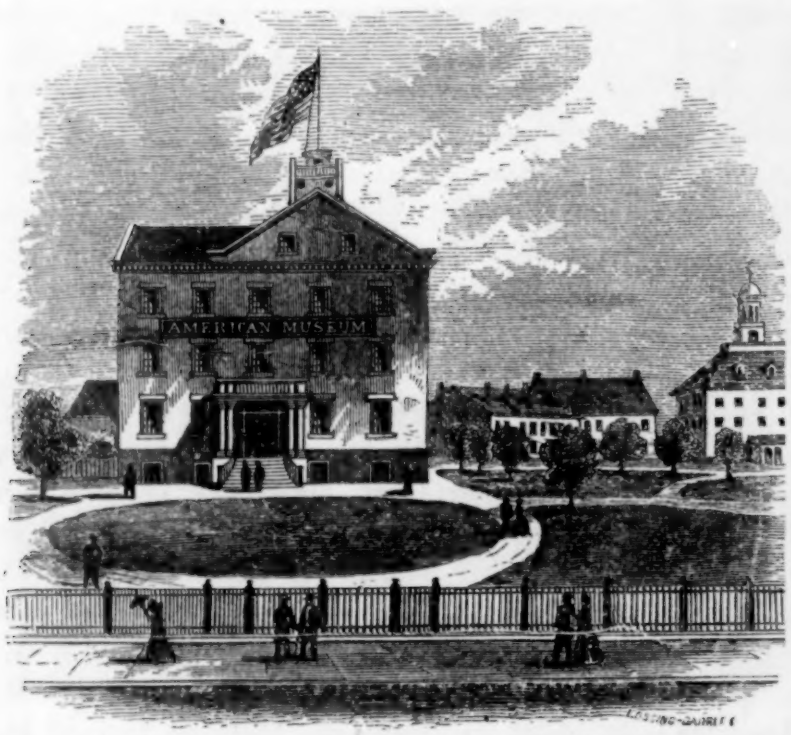
John Scudder, the predecessor of Barnum and Peale, established a pay museum of some merit in 1810. It was praised in very mellifluous English by a contemporary who rejoices that "it continues daily to improve, by extensive and valuable additions of the *works of nature* and artificial curiosities, from all parts of the world. Its immense collections are well arranged and beautifully displayed in four spacious saloons, each 100 feet in length; in addition

*We were indebted to the kindness of S. D. Avery, Esq., for the privilege of inspecting this interesting pamphlet, a notice of which was first printed in the New York *Times*, Saturday Review, July 1, 1899.

to which another department has recently been added of still larger dimension." This museum was on the ground now occupied by the St. Paul Building, opposite St. Paul's Church, Broadway. Fitz Green Halleck describes it as:

"Once the almshouse, now a school of wisdom,
Sacred to Scudder's shells and Dr. Griscom."

Peale's Museum and Gallery of Fine Arts stood on Broadway opposite to City Hall Park. It was founded in 1825. It is impossible to withhold at least a partial quotation depicting its attractions as given by the veracious Disturnell.* "It contains four spacious apartments, which are arranged in the following order: The 1st contains *specimens of natural history in all its branches*, and for beauty of arrangement, and the exquisite style in which the articles are mounted, render it one of the most interesting places of public amusement in the country. The 2d is a large and valuable collection of paintings, by eminent artists, amongst which may be particularly mentioned a portrait of Napoleon by Le Fevre; a Magdalen by Le Brun, together with portraits of at least 150 celebrated citizens and foreigners. The 3d contains a very superior Cosmorana, several wax figures of good workmanship, fossil shells, minerals and miscellaneous curiosities."



New York Institution. 'The Old Almshouse.' Western end facing Broadway.

As early as 1801 botany at least achieved in New York a notable recognition. It was then that Dr. David Hosack purchased the Elgin domain and created there a botanical garden. This property of twenty acres was between 5th and 6th avenues on 47th and 51st streets. Here, to quote the elegant Dr. Francis, "were associated in appropriate soil, exposed to the native elements or protected by the conservatory and hothouse, examples of vegetable life, and of variety of development—a collection that might have captivated a Linnæus or a Jussieu: and here indeed a Michaux and a Barton, a Mitchill, a Doughty, a Pursh, a Wilson or a Le Comte often repaired to solve the doubts of the cryptogamist or to confirm the nuptial theory of Valliant."

This effort of Dr. Hosack's was a natural, though distant, precursor of a scientific museum.

Associated with Gardiner Baker in the organization of the American Museum was John Pintard, who laid the foundation of the N. Y. Historical Society. This institution gathered strength rapidly, as might have been expected, and its museum of his-

* 'New York as it is in 1837 containing a general description of the City of New York, list of officers, public institutions, and other useful information. Including the public officers, etc., of the city of Brooklyn, accompanied by a correct map—published by J. Disturnell, 1837.'

torical treasures increased and expanded, and led a migratory life of more than 50 years, in which it wandered successively from the old City Hall, in Wall Street, to the Government House, in Bowling Green, to the N. Y. Institution, to the Remsen Building, on Broadway, to the Stuyvesant Institute, to the N. Y. University, until finally, in 1857, they rested permanently in the present home of the society at Eleventh Street and Second Avenue (History of N. Y. City, Benson J. Lossing). This society's collections assumed at this latter date the character of a museum in a popular sense, for at this time it secured the possession of Dr. Abbott's collection of Egyptian antiquities.

As early as 1854 Dr. Abbott's collection of Egyptian antiquities was brought to this country by its distinguished owner and an effort made to secure for it an appropriate home in America. Dr. Abbott, during a residence of more than twenty years in Egypt, where he had served as a physician in the army of Mehemet Ali during the Syrian war, had spared no pains and apparently little expense in the accumulation of a museum of Egyptian antiquities. The reception of his project was disappointing and hardly creditable to New York, where the collection it was expected would receive a proper reception. It did not, however, undergo the misfortune of being lost to the city. Several friends of Dr. Abbott and many gentlemen of influence and means, amongst whom was Peter Cooper, secured for it at least temporary security and it was placed in an apartment in the then New Institution, now the Cooper Union Hall, in Astor Place. The amount required was $60,000. The editor of *Harper's Magazine* urged its purchase on the grounds that it 'would be the nucleus of a generous and extensive historical, scientific and artistic museum, which would give New York an elevated rank as a real, and not a pretended and assumed, metropolis among the great cities of the world.' Such opinions, prevalent in the prints of the time, show how widely emphasized was the need of a great museum for the city. The Historical Society subsequently became the possessor of an immense art collection, numbering 1,000 examples of paintings and sculpture.

The project of a permanent crystal palace is familiar perhaps to the older men of our day, and the history of that elusive scheme, from the day when it opened as a World's Fair to its extraordinary half-ludicrous climax as a stock company, and a faint reflex of Sydenham Palace, under Barnum's direction, a well-remembered chapter in the events of half a century ago. In May, 1853, the approaching completion of the Crystal Palace was hailed by the New York public and by the large expectant population of its suburbs with delight and pride. It was at first a World's Fair, and in the sketches of the time we meet expressions of interest in which are mingled quite indiscriminately delight over its completion, and pleasure at the prospect of the Franconi hippodrome and a stupendous tower for panoramic views. The Crystal Palace was a wonderfully attractive building. It was modeled after the Crystal Palace of London, but was a really more admirable architectural work. It occupied the ground now known as Bryant Park, and covered five acres of ground. Its roof was supported on iron columns and the spaces between them were closed in by glass. It was a marvelous creation of Moorish and Byzantine composition. The annual fairs of the American Institute were held here, and it was perhaps the first seriously and generously conceived effort at the work and mission of a museum. It was known as the New York's Industrial Exhibition, and while it largely partook of the ephemeral bizarre and commercial character of a fair, it enlarged the

mind of the public by a display of both nature and art, and was a logical excitant of those desires in the scientific and artistic spirit of New York that led finally to the establishment of our art and scientific museums. During the season of the World's Fair the art and the products of Denmark, France, England, Germany, Belgium, Holland, were here superbly housed, and the illuminating effect upon our people cannot be overestimated. Its mention is essential for an appreciation of the conditions preliminary and formative to the erection of the present Museum of Natural History.

Those various enterprises and events so briefly epitomized would not of themselves have provided exactly the sort of stimulus required to bring to a procreant stage the undefined wishes of the leading citizens of New York for a great museum. This stimulus was provided, however. It arose from two separated centers of scientific activity, the organization of a Natural History Survey of New York State, and the persuasive influences emanating from Louis Agassiz at Cambridge.

Zoology in New York State received an early recognition in the labor of Samuel L. Mitchill, who in 1813 commenced an account of the fishes of the State, which, however, when published became a local review of the fishes near New York City. Contributions to the ornithology of the State were frequent, apart from the general works of Wilson, Bonaparte, Audubon, Cooper and DeKay, and William Cooper; Bachman, Le Conte, Barnes, Jay, Bailey, added fresh studies in herpetology, mammalogy, conchology and microscopy. As early as 1799 Mitchill had collected facts relative to the mineralogy of New York State, and he was succeeded by less-known names, until T. Romeyn Beck published in 1813 a more valuable review of this subject. The interest in the natural productions grew, and public attention and public funds became gradually involved in the examination. Stephen Van Rensselaer in 1820 authorized Amos Eaton and T. Romeyn Beck to make a survey of the county of Albany. This was later extended to Rensselaer County, and over the line of the Erie Canal, the latter exploration producing Eaton's famous geological nomenclature and scheme of New York geology. The realization amongst public officers that the time was ripe for a thoroughly organized survey was more and more strengthened. In 1835, upon the motion of Charles P. Clich, a representative from New York, the Assembly of this State passed a resolution directing the Secretary of State, John A. Dix, to report upon the most expedient plan for a complete geological and natural-history survey of the State. Secretary Dix made the report, and on the 15th of April, 1836, this great survey was sanctioned by the Legislature, its maintenance provided for, and James E. DeKay, John Torrey, Lewis C. Beck, William W. Mather, Ebenezer Simmons, Timothy A. Conrad, Lardner Vanuxem and later James Hall were organized into a scientific directorship of its interests. The immediate result of this survey was the erection of a museum in Albany, and a new conception given throughout its publications to the importance of natural science. In 1869, the year immediately preceding the foundation of the museum, the survey had been in operation some thirty years, and Professor James Hall had gathered together a private collection of remarkable dimensions, representing the paleontological history of the State. A lesson, if exhibited instructively to the public, in geological events was here concealed, and only the facilities and purposes of a great museum could properly present it. The entire range of facts embodied in the reports of the survey and those of the New York State Cabinet had sensibly deepened the growing impression and expectancy that a great city must

assume the responsibilities of such an institution. This collection of Professor Hall's was for sale and its possession would be of inestimable value to a new institution.

The second and presumptively more effective influence shaping the thought of our citizens in this direction was the enthusiasm over the work and lectures of the great Swiss naturalist, Louis Agassiz. Agassiz's own success in securing the cooperation of the Massachusetts State Legislature to create the Museum of Comparative Zoology at Cambridge was a pioneer effort along lines followed quite closely by the American Museum of Natural History. It was indeed upon the inauguration of the Museum of Comparative Zoology that the second group, as Marcou has observed, of Agassiz's pupils, was formed, a group that disseminated over the entire United States a new love for natural science, and formed in themselves a radiant center of genius and industry.

Louis Agassiz, the Swiss naturalist who had declined the flattering and profitable offers of the French government to fill a position of superintendence over the Museum of Natural History or Jardin des Plantes in Paris, also the chair of paleontology in the State University of Switzerland, had established himself in the affections of America. His lectures were revelations, and the public of New York, as of almost every other great city, had been awakened to a new sense of appreciation of the study of nature. A series of distinguished men had imbibed from his contagious enthusiasm for nature, and had elevated the fame and established the permanence of American science; amongst these were Allen, Scudder, Verrill, Putnam, St. John, Morse, Emerton, Hyatt, Shaler, Ordway, Stimpson, Niles, Lyman, Clark, Mills, Packard, Dall, Mann, Uhler.

Agassiz's association with Bache, Gray, Morton, Leidy, Baird, Wyman, Pourtales, Lesquereaux, Rogers, Conrad, Guyot, Marcou, in the higher scientific circles of America, and his intimacy with Emerson, Whittier, Longfellow, Felton, Lowell, Holmes, Binney, Hoar, Ticknor, Howe, Sumner, in the social regency of Boston, had created for him a personal preeminence quite unique in the United States. Certainly Agassiz's relations with all his pupils had not been invariably honorable to himself, but even the famous 'Salem Secession' with its resulting publication of *The American Naturalist* only served to give a wider prominence to his peculiar and fascinating enthusiasm.

And in 1860 Agassiz's long-cherished scheme of founding a great museum materialized in a conspicuous inauguration of the building of the Museum of Comparative Zoology in Cambridge. The Governor and his staff and a great concourse of people, with the faculty of Harvard College, were present, and the event, dwarfed indeed by the imminence of a terrible conflict, distinctly foreshadowed the development and expansion of the museum idea in the large cities of the Union.

Amongst those early engaged in the duties of this museum was Albert S. Bickmore, a young man then, who, in a succeeding year, entered the service, and being detailed to duty near the seashore, seized the occasion to revive his studies of sea-life by making a collection of the coast shells of North Carolina. Professor Bickmore had noted with interest Agassiz's supple combination of tact, eloquence and personal charm in securing the effective alliance of the Commonwealth of Massachusetts, and his adaptability to the methods of private importunity. Through these combined agencies the Legislature of Massachusetts had granted $100,000, the citizens of Boston raised $71,000, Mr. Francis C. Gray left $50,000, and a sentiment of generous appreciation for the purposes of the museum had

been created. Agassiz's success in this way was remarkable. He obtained under the most discouraging circumstances, even in the darkness of the war, large sums of money from the Legislature of Massachusetts, and his appeal to individuals was always irresistible.

It seems pertinent, in view of the analogous relations of the New York museum to the Legislature of the State and private benefactors, to quote Marcou's expressive description of Agassiz's methods. Agassiz's biographer writes: "The amount of scientific diplomacy he made use of is something astounding; for instance, he would detail with great clearness the working of the institution, and make it clear that the museum is an element of education even in the most elementary school of commonwealth, and that in the future generations there would not be a child who would not have the opportunity of understanding the scheme of creation as thoroughly as he understood his multiplication table. He had the tact to adapt his explanations and his description of the absolute poverty of the institution to the listener and his official position in the State. Then, after weeks of such preparatory work at the State House, came the annual visit of the whole legislative body, with the Governor at its head, to the museum. Everything was in readiness for the reception when the six or ten street cars, filled with legislators, arrived at the University grounds. Agassiz conducted them at once into the various exhibition halls, showing the treasures of each and briefly describing the departments. Afterwards in the lecture room, in an informal conversation, he detailed the methods and needs of the institution. He always succeeded in winning to his side farmers, tradesmen and politicians. After such a visit the Legislature always voted a new appropriation of public money; it was only necessary for the President of the Senate and the Speaker of the House to make speeches in its favor, and the resolution would easily pass the three readings without further debate."

Celebrated collections of the Old World, constant accessions from the new, were pouring into the museum at Cambridge. In 1869 Professor Agassiz reported that though the income of the British Museum and the Jardin des Plantes was more than ten times that of the Museum of Comparative Zoology, yet the last "in certain departments, such as corals and fishes, was superior to both, and that in activity of research and publication it yields to neither, while the increase of its collections since its existence, and the prominence it has attained among the museums, are such as no like establishment has reached in the same time and with the same means."

It was with anxious eyes that the naturalists of New York and those citizens of the great metropolis that were devoted to the advancement of its intellectual interests noted this rapid progress. The formative period closed, and the crystallization of an idea, so definitely recognized, quickly succeeded in those years, which included the incorporation of the American Museum of Natural History.

L. P. Gratacap.

American Museum
of Natural History.

SCIENTIFIC BOOKS.

Publications of the Japanese Earthquake Investigation Committee. Nos. 5 and 6. Tokyo. 1901.

These two volumes are continuations of the series of publications in foreign languages of the investigations of the Imperial Japanese Seismological Committee, the earlier numbers of which received a somewhat extended notice in the columns of this journal some time ago. They are written by Dr. Omori, a member of the Committee in immediate charge of the investigations, and they contain horizontal pen-

dulum observations of earthquakes during 1898 and 1899, together with a detailed description of the horizontal pendulum seismographs used and some discussion of the results.

In the 'compound,' or park, at Hongo, Tokyo, in which the buildings of the Japanese Imperial University are located, there has been erected an 'earthquake-proof' house in which two of the large horizontal pendulums are placed. They are of rather unusual dimensions, the vertical distance from the point of suspension to the point of support being nearly three meters. The pendulum is excellently planned for stability and convenience of adjustment, and is capable of a vibration period of as long as three minutes, being, therefore, extremely sensitive. When adjusted to a period of two minutes it will show an index displacement of about 1 mm. for a change of level of about one two-hundredth of a second. Two of these seismographs, exactly alike, are mounted, one to give the N. and S. component of the disturbance and the other E. and W. component. They are designed, of course, for the registration of very feeble but often long-continued disturbances whose seismic origin is remote from the point of observation. Concerning the transmission of such disturbances many extremely interesting observations have been made, only a few of the most important of which can be referred to here.

Broadly speaking, the motion of an earthquake may be divided into three successive stages, which are always more or less well defined; *the preliminary tremor*, consisting usually of vibrations of small amplitude and short period; the *principal portion*, the active and often destructive part of the earthquake, during which the amplitude is much greater and the period usually longer; the *end portion*, which is the feeble, small amplitude finishing of the disturbance. The first of these is again usually quite sharply divided into two stages, which may be designated as the first preliminary tremor and the second preliminary tremor, and the *principal portion* is also made up of three tolerably distinct phases, of which the last, designated as the *quick-period phase*, is of the greatest importance in the present discussion.

Several seismologists have already pointed out the fact that the duration of the *preliminary tremor* of an earthquake increases with the distance of the seismic center from the place of observation, and this proposition is not only confirmed by Dr. Omori's observations, but from them and some others he has been able to deduce an equation which represents the relation between duration and distance with astonishing closeness. Sometimes the total duration of these disturbances, due to distant earthquakes, is as long as four hours, but the equation here given is based upon first preliminary tremors varying in duration from five minutes to eleven minutes. It is as follows:

$$x = 17.1y - 1360$$

in which x is distance in kilometres (on the surface of the earth along the arc of a great circle passing through the two points) and y is the duration of the *first preliminary tremor* in seconds. This equation is based on long-distance observations of several earthquakes, three of which, occurring respectively in Alaska, Smyrna and Japan were observed in Japan, while others originating in Japan were observed in Potsdam and Italy. The agreement of the calculated values of x with the actual values is shown in the following table:

Earthquake.	Actual Distance.	Calculated Distance.
Alaska,	6,100	6,500
Smyrna,	4,800	4,560
Java,	9,200	9,240
Japan,	8,999	8,840
Japan,	9,580	9,540

Perhaps the most interesting subject discussed in these volumes is the transmission velocities of the various phases of an earthquake disturbance. Dr. Omori has given much attention to this important question, considering it in considerable detail in the light of his own and other recent observations. It has long been known that all seismic waves did not travel with the same velocity, and it was long ago suspected that different phases of the same disturbance might be transmitted at very different speeds. During the past few years the development of 'long-distance seismology,' as it may be called, has added greatly to our knowledge of velocity of transmission, and at the same time it has materially increased the difficulties by which the subject is surrounded.

Dr. Omori has compared the time of the arrival of the beginning of three of the phases mentioned above, namely the *first preliminary tremor*, the *second preliminary tremor*, and the *quick-period* phase of the *principal portion*, and he has assumed, as he is quite justified in doing, that they originated simultaneously at the seismic origin. He has compared the velocities of transmission of these three phases between Italy and Japan, in ten earthquakes, with results which agree among themselves in the most remarkable way.

The means are, for the *first preliminary*, 12.8 km. per second; the *second preliminary*, 7.2 km. per second, and for *quick period* of the principal portion 3.3 km. per second. The latter quantity, it will be observed, is what is usually thought of in speaking of the velocity of an earthquake wave.

Now no known rock has a modulus of elasticity high enough to transmit a wave, of either compression or distortion, with the speed of the *first preliminary tremor* as shown above, and it seems impossible to avoid the conclusion that this disturbance must be transmitted along some shorter path within the earth's crust, while the *principal portion* undoubtedly travels along the earth's surface. This question is greatly complicated, however, by the fact that the duration of the *first preliminary* at a given observation station is very nearly simply proportional to the *surface* distance from the origin of the disturbance.

It is impossible to close even so brief a notice as this must be, without again congratulating Dr. Omori and his colleagues of the Earthquake Commission upon the splendid way in which they are making use of the rare opportunities which they enjoy for seismological study. The indirect results of this study, especially as they are related to the general subject of terrestrial physics, promise to be of the greatest importance, and the Japanese seismologists may well feel assured that they are practically in control of a field worthy of their highest efforts.

The general form and style of these publications is so excellent that it may be worth while to call attention to the existence of a few blemishes, doubtless due to careless proof-reading. One is tempted to especially mention one of these, which is the frequent appearance of *Alasca* or *Alascan*, in which form alone, indeed, is found the name of the territory, or whatever it may really be, known to us who own it as Alaska.

T. C. Mendenhall.

Beitrag zur Systematik und Genealogie der Reptilien. By Max Fürbringer. Abdruck aus der *Jenaische Zeitschrift für Naturwissenschaft*, XXXIX. Bd. (N. F. XXVII.). Jena, Verlag von Gustav Fischer. 1900. Pp. 1–91.

The paper to which the attention of all who are interested in the class of reptiles is here called is only a portion of an extensive memoir, a summing up of the results of studies detailed in the twenty-seventh volume of the *Jenaische Zeitschrift* and occupying over four hundred pages of that journal. In view of the author's important contributions to zoological literature, especially of his great work on the morphology of birds, anything that he may have to say on the kindred group of reptiles must attract attention.

The author first discusses the position of the most primitive Reptilia and the origin of the Sauropsida (I.); then a survey is made of the systematic and genealogical relationships of the various orders (II.); and finally, these are grouped into subclasses, and their genealogical relation to the other Tetrapoda is treated (III.).

I. Of the living reptiles the Lacertilia and the Rhynchocephalia are regarded as the most primitive; of the latter a single representative exists; of the Lacertilia about 1,600. Contrary to what is generally held, the author does not regard *Sphenodon* as the most primitive reptile, although it possesses many primitive features. A just appraisement of all its characters places it lower than the highest Lacertilia, but higher than the lowest representatives of the latter. The author contends that in the primitive reptiles the quadrate bone was movable (streptostylic), and that its fixed (monomostylic) condition is the result of secondary modifications. Some of the earlier Rhynchocephalia, as *Pateohatteria*, were probably the lowest of known reptiles. Notwithstanding their differences, the Lacertilia and the Rhynchocephalia had a common ancestor.

As to the origin of the Sauropoda, Fürbringer holds that they sprang from amphibian ancestors whose quadrate was streptostylic.

II. The author regards the lizards and snakes as constituting two distinct orders. The snakes are not further considered. The Lacertilia are divided into five suborders, viz., Lacertilia vera, Varano-Dolichosauria, Mosasauria, Amphisbænia, and Chamæleontia. Among the true Lacertilia, the Geckos are the lowest of living reptiles. In many characters the Varanidæ stand apart from other Lacertilia. The Mosasaurs are regarded as Lacertilia which at an early period branched off from perhaps near the ancestors of the Varanidæ, and became pelagic. The author finds in the Chamæleontia numerous points of resemblance with the Lacertilia vera, especially with the Uroplatidæ. They are hence placed closer to the lizards than in the system of Boulenger, but farther removed from them than in the system of Cope.

As regards the Ichthyopterygia, Fürbringer holds that they possess close relationships with the Rhynchocephalia, but are widely removed from the Sauropterygia. The Chelonia are not thought to be related to the Theromorpha, but rather to the Sauropterygia. The special phylogeny of the Chelonia is veiled in darkness. The Trionychidæ are considered to be the lowest in rank of living tortoises, the Pleurodira the highest. The isolated position in which *Dermochelys* has been placed by some writers is not accepted. The small group of Mesosauria of the Permian and Lower Triassic find their relationships with the Sauropterygia, Chelonia and Theromorpha; nevertheless they display many peculiarities.

The Theromorpha appear in the Permian and lower Triassic in great numbers and in varied forms; but with the Triassic they disappear. Many of them became highly specialized, attained considerable size, and developed, to a remarkable degree, stoutness of body and of its component parts. Their relationships are held to be with the Rhynchocephalia, but not close. They have no affinities with the Chelonia. In connection with this group the author discusses the origin of the Mammalia. His conclusion is that they have sprung from no group of reptiles, but directly from the Batrachia.

The Crocodilia are held to be the highest of living reptiles. They have distant connections with the Lacertilia and the Rhynchocephalia; closer ties with the Dinosaurs. The extinct groups Parasuchia and Pseudosuchia are to be retained close to the crocodiles.

In rank the Dinosauria stand above the Crocodilia, with which group they show many affinities. Two characters possessed by the higher forms lift the Dinosauria above the Crocodilia, the upright mode of progression and the development of cavities in the bones. The Dinosaurs are accepted as a single order, to be divided into two or three suborders.

The Pterosauria are estimated to be the highest in rank of all known Reptilia. They are specially related to the crocodiles and the Dinosaurs. Any close relationship to the birds is rejected.

III. Finally, the various orders are grouped by our author into subclasses. The first contains the Lacertilia, Ophidia, Rhynchocephalia and Ichthyopterygia; and for his subclass Haeckel's name Tocosauria is appropriated. The second subclass is constituted by the Theromorpha. A third subclass is formed of the Mesosauria, Sauropterygia and Chelonia; and to this the name Synaptosauria is applied. The Crocodilia, Dinosauria and Pterosauria make up the subclass of Archosauria.

O. P. HAY.

AMERICAN MUSEUM NATURAL HISTORY,
NEW YORK, July 4, 1901.

Allegany County, Maryland. By WM. B. CLARK, State Geologist. Md. Geol. Surv., Baltimore, Md. 1900.

This royal octavo volume of 323 pages, accompanied by a folio of 6 pages containing topographic, geologic and soil maps of the county on a scale of one mile to the inch, is the first of a series of descriptive reports by counties to be published by the Maryland Survey. Not only the geology, mineral resources and physiography are described, but also the soils, climate, hydrography, magnetic declination, forests, flora and fauna. In addition to its general scientific value, it is of unusual interest to the county, presenting invaluable data for the farmer and manufacturer, and furnishing a

most excellent means of education and instruction to the inhabitants by interesting them in the local phenomena and the history of the mountains and the rocks forming them.

The physiography is by Cleveland Abbe, Jr., and the geology by Cleophas C. O'Hara. The county is in the western part of the State, embracing parts of the Allegheny Plateau and the Great Appalachian Valley. The rocks exposed in the plateau district are of Carboniferous and possibly Permian age and have been folded into a flat northeast-southwest syncline. The upturned resistant Pottsville conglomerate forms the eastern edge of the plateau in a straight even-crested ridge, and the interior of the plateau is composed of the softer overlying rocks protected in the syncline to the west. The Ridge district, embracing that part of the county in the Great Appalachian Valley, is composed of Silurian and Devonian rocks folded into numerous open parallel northeast-southwest folds, generally with steeper dips to the northwest, but not overturned or overthrust. Erosion has produced long parallel sharp-crested ridges separated by narrow valleys.

The remains of two physiographic plains have been recognized in the topography. The older, called the Schooley Plain, is preserved only in the crests of the higher ridges. The younger, called the Shenandoah Plain, is represented by the tops of low ridges and knolls between 900 and 1,100 feet elevation along the margins of the larger streams. This latter plain consisted of broad valleys between high ridges which were not reduced during that cycle of erosion. Two terraces of recent date were observed in the stream gorges, marking temporary halts in the downward cutting of the streams. Some very interesting stream adjustments are described. The geologic history of the region is also interestingly presented.

Among the mineral resources mentioned, the more important are coal, fireclay, cement rock and iron ore. Excellent steam coal has been mined in the county for many years, and the district is known as the Cumberland-Georges Creek Basin. Several important beds are mined and are distributed vertically through the Pottsville and Coal Measures. The Big Vein or 14-foot Vein occurs in the upper part of the series, and is noted for its great size, purity and fine steam quality. The report on the economic products is by Wm. B. Clark, C. C. O'Hara, R. B. Rowe and H. Ries.

The soils of the county are represented on the geological map, the subdivisions corresponding to the divisions of the underlying rocks, but a separate legend giving the descriptions of the soils. Mechanical and chemical analyses of the various soils are given in tabular form and their value for agriculture is discussed. Clarence W. Dorsey is the author.

The hydrography and the remaining subjects presented in the report, as well as the soils, were surveyed in cooperation with branches of the U. S. Government and the reports are presented by members of the government corps.

The volume is handsomely printed and illustrated with half-tone cuts in the same excellent manner as in former publications of the Survey. The atlas accompanying the report is a high-grade lithographic production. The topographic map is that prepared by the U. S. Geological Survey in cooperation with the State. The colors and patterns used on the geologic maps are the same as those used by the U. S. Government and the results obtained are very pleasing. The publication by counties, however, makes it necessary to dissect the maps awkwardly and print them on three sheets, and makes the folio of unhandy size.

George W. Stose.

Washington, D.C.

SCIENTIFIC JOURNALS AND ARTICLES.

The *American Geologist* for May contains a biographical sketch of Elkanah Billings with portrait by Henry M. Ami. Dr. J. B. Woodworth contributes an article on 'Cross-Banding of Strata by Current Action.' He describes micaceous bedding in the glacial sand near Lake Walden and attributes its formation to the vertical movements of the water about the crest of a current mark. This is followed by 'A Historical Outline of the Geological and Agricultural Survey of the State of Mississippi,' by E. W. Hilgard. This is followed by 'Reviews of Recent Geological Literature' and 'Scientific News.' The June number contains the follow-

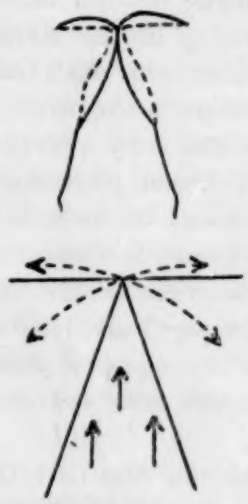
ing articles: 'The Ontario Coast Between Fairhaven and Sodias Bays,' by J. O. Martin. Some peculiar features of the landscape due to the rapid erosion of the glacial drumlins along the shore line are described. 'Eighth Session of the International Congress of Geologists, Paris, 1900,' is written up by Persifor Frazer. 'Two New Genera and Some New Species of Fossils from the Upper Paleozoic Rocks of Missouri,' by R. R. Rowley. Mr. Rowley describes two new genera of blastoids and proposes the names *Lophoblastus* and *Carpenteroblastus*, following which he describes two new species of the first, one of the second, and fourteen of the other genera of fossils from the same region. The article is accompanied by a plate. 'Ore Formation by Surface Decomposition,' is discussed by C. R. Keyes, in which he concludes "that with the exception of possibly a few isolated unimportant instances ore concentration does not generally take place through surface decomposition of rock masses, in areas such as the Ozark lead and zinc region." 'Gold and Other Minerals in Iowa,' by Samuel Calvin. The author undertakes to destroy the fallacious ideas that gold, gas or oil exist in paying quantities in Iowa. He also exposes the fallacy that any so-called geologist with a drilling outfit is to be trusted in his predictions to a public-spirited community.

DISCUSSION AND CORRESPONDENCE.

THE LARYNX AS A MUSICAL INSTRUMENT.

THE wide prevalence of the mistaken notion that the vocal cords vibrate in the axial direction of the larynx makes it desirable to point out that observations by the laryngostroboscope—a combination of a laryngoscope and an adjustable intermittent source of illumination—have proved to the contrary for the male chest register. With this method it is possible to follow a vibration slowly through its phases. This has been done by Musehold, who reports that in singing in the chest register the cords touch along their whole length; that in loud tones the edges have a slightly rounded form, especially in the middle, indicating strong contact in the middle and weaker contact at the ends of the glottis; that in weaker tones the line of contact appears even and thin while the top of the cord becomes flatter; that the edges of the cords move out sidewise and not in the axial direction of the larynx. Two of Musehold's diagrams are reproduced here. The upper one shows the bunching of the cord edges due to the firm contact; the lower one is an indication of the way the air pressure in the trachea presses the cords apart.

In connection with the remarks of Professor Le Conte on a previous occasion, it is interesting to note that with the same method Musehold was able to observe the lips of a performer on a horn, with the result of seeing that the lips vibrate as cushions and not in the direction of the axis of the horn.



In Professor Hallock's interesting communication in the last number of SCIENCE, the microscopic section of one of the cords is correctly given, but the diagram of the supposed way in which the muscle turns into a thin sheet is certainly incorrect. It is hardly the place here to give a summary of the facts in regard to the action of the vocal cords and the nature of the vowels in speech and song; I have stated in a previous communication that the proof is clear and complete that a vowel both in speech and song is not essentially a fundamental from the cords with a series of overtones reinforced by the vocal cavities. I may, perhaps, be pardoned for saying that I have given a digest of the many investigations on this and related subjects in a work on experimental phonetics now in press.

E. W. SCRIPTURE.

YALE UNIVERSITY,
July 26, 1901.

SHORTER ARTICLES.

THE ORIGIN OF TRAVERTINE FALLS AND REEFS.

In a recently published article, Professor Davis, in speaking of certain travertine cascades and reefs, says: "We could not find any satisfactory explanation for the growth of these travertine reefs,"* and he refers to an occurrence of falls over travertine reefs in Central America as if such deposits were unusual.

In the limestone regions of East Tennessee travertine cascades are common. A creek that enters the Frenchbroad river a mile and a half above Dandridge, Jefferson county, has a series of travertine falls where the stream emerges from the hills upon the bottom lands of the river. The narrow valley of the stream is in places completely floored over with travertine. Similar deposits occur in the town of Dandridge, especially near the ferry over the Frenchbroad, where a small stream pitches over the edge of the bluff. At many of the falls the deposit has grown outward until the water pours over bellied protrusions of the travertine. It is worthy of note in that particular region that springs whose waters are equally charged with lime deposit no travertine where they flow quietly into the river.

In the vicinity of Stanford University, California, some of the streams descending from the calcareous areas of the Coast Range are heavily charged with lime and deposit travertine wherever the waters are thrown into spray. Like most mountain streams they descend by a series of terraces, or steps, represented by quiet stretches having little cascades at theirup-stream and down-stream ends. These cascades are made of rocks, frequently water-worn boulders, and in every instance the boulders at the cascades are covered with more or less travertine, while similar boulders along the quiet stretches and especially in the deeper waters are without the travertine.

The waters of Congress Springs, in Santa Clara County, California, are highly charged with carbon dioxide and carry much lime in solution. The water is now conducted through open wooden troughs to storage tanks, and wherever the troughs are so steep that the water is rippled the travertine is rapidly deposited and has to be removed from time to time in order to prevent the complete filling up of the troughs. The old stream bed along which this Congress Spring water formerly ran is covered with travertine wherever the water was rippled. At one place along this old channel there is a bank of travertine eight or ten feet high.

These phenomena are to be seen at many other places in the foothills around the sides of the Santa Clara Valley.

At Santa Cruz, California, a stream flowing out of a hilly limestone region, where it emerges from the hills, has deposited a bed of travertine that is probably fifty feet or more in thickness and covers an area of several acres.

Perhaps the most remarkable deposits of the kind are those along the western coast of Palestine and the southern coast of Asia Minor, where the streams pass over regions of limestone. They are frequently spoken of in works upon that region.*

Whether these deposits are all made in the same way or by a single process is doubtful. In the case of the highly carbonated waters of Congress Springs it seems most probable that the deposition of the lime is due chiefly to the escape of the carbon dioxide when the water is exposed to the air by rippling or spraying. In the cases of streams that run for some distances in open channels before giving up their lime it may be that the deposition is due, at least in part, to the increase of the temperature of the water and the loss of carbon dioxide. But inasmuch as the travertine is formed most abundantly at the falls, it appears that the spraying of the water is an effective agency in the escape of the gas. It is well known also that certain aquatic plants help precipitate lime from water by the absorption of carbon dioxide. An interesting case of the kind is mentioned by Clarke,† and other papers have lately been pub-

* 'An Excursion into Bosnia, Hercegovina and Dalmatia,' by W. M. Davis, Geological Society, Phila., III., 42–44.

* 'Karamania, or a Brief Description of the South Coast of Asia Minor,' etc., by Francis Beaufort, 2d ed., London, 1818.

† *Bull. New York State Mus.*, VII., 195–98.

lished by C. A. Davis * and by Blatchley and Ashley.†

My observations upon the growth of stream deposits of travertine in Tennessee and California led me to the following conclusions:

1. The deposits grow more rapidly in the summer and at low-water stages.

2. The channels become locally choked up with travertine and the streams are compelled to shift from side to side.

3. The thin horizontal beds of travertine are formed in the shallow waters immediately above the falls.

4. Although the larger streams appear to be eroding and do erode at high stages and at certain parts of their courses, the process on the whole is constructive.

5. The travertine tends to form a series of terraces along the streams depositing it.

J. C. BRANNER.

STANFORD UNIVERSITY, July 4, 1901.

PSEUDOSCOPIC VISION WITHOUT A PSEUDOSCOPE.‡

A METHOD of securing an illusion of binocular vision wholly without instrumental aid occurred to me recently, which is interesting in connection with the study of pseudoscopic vision. It is fully as startling as any of the results obtained with the lenticular pseudoscope, which I described in SCIENCE (about Nov., 1899), and, requiring the aid of no optical instrument, is very much more impressive. A lead pencil is held point up an inch or two in front of a wire window screen, with a sky background. If the eyes are converged upon the pencil point, the wire gauze becomes somewhat blurred and of course doubled. Inasmuch, however, as the gauze has a regularly recurring pattern the two images can be united, and a little effort enables one to accommodate for distinct vision of the united images of the mesh. To accommodate for a greater distance than the point upon which the eyes are converged requires practice, but the trick is very much easier in this case than in the case of viewing stereoscopic pictures without a stereoscope. As soon as accommodation is secured the mesh becomes perfectly sharp, and appears to lie nearly in the plane of the pencil point, which still appears single and fairly sharp. If now the pencil is moved away from the eyes, which are to be kept fixed on the screen, the point *passes through the mesh* and appears double, the distance between the two images increasing until the point touches the screen.

If now the pencil be removed it will be found that the sharp image of the combined images of the gauze persist, even though the eyes be moved nearer to or farther away from the screen. Move the eyes up to within six or eight inches of the plane in which the screen appears to lie and try to touch it with the finger. *It is not there.* The finger falls upon empty space, the screen being, in reality, a couple of inches further off. This is by all means the most startling illusion that I have ever seen, for we apparently see something occupying a perfectly definite position in space before our eyes, and yet if we attempt to put our finger on it, we find that there is nothing there.

It is best to begin by holding the pencil an inch or less in front of the screen. As the eyes become accustomed to the unusual accommodation the distance can be increased. The greater the distance, the greater the illusion, of course. I have succeeded in bringing up the apparent plane of the mesh five or six inches, but this requires as great a control over the eyes as is necessary in viewing stereoscopic views without an instrument.

R. W. WOOD.

THE BOTANIST'S JOURNEY TO THE DENVER MEETING OF THE A. A. A. S.

FOR the observing botanist (and what kind of a botanist is he who is not observing?) the journey to the Denver meeting of the American Association for the Advancement of Science will be of the greatest interest. Leaving the originally wooded country some distance east

* *Jour. of Geology*, Sept.–Oct., 1900, VIII., 485–503.

† 'The Lakes of Northern Indiana and their Associated Marl Deposits,' by Blatchley and Ashley, 25th Ann. Rep. State Geologist of Ind., pp. 43–51.

‡ Since writing this note I have learned that a similar illusion is described in Le Conte's 'Sight.' It may however be new to some.

of Chicago, he enters the level prairies of Illinois, originally treeless except along the watercourses, and passes from these to the rolling prairies of Iowa, whose undulating surface was wanting in woody vegetation except in the broad valleys which border the streams. Now, as in Illinois, all over the landscape are lines and clumps of vigorous trees, all the result of man's work. What was once a treeless view is now as freely dotted over with trees as in the case of many a landscape in the originally wooded portions of the eastern United States. Crossing the Missouri River he soon enters the region of the Great Plains, with an elevation of 1,200 feet above the sea at the eastern border, rising rapidly across Nebraska to 2,000, 3,000 and 4,000 feet above the sea. If he follows the broad valley of the Platte River from Omaha to Denver, he will receive the impression that the Plains are 'as level as a house floor,' since he sees only the flat alluvial plain worn by the great river, and is ignorant of the fact that on each side are hills and valleys stretching away for hundreds of miles, the hills treeless as in the prairies, and the valleys with groves of trees along the margins of the streams. If he is fortunate enough to choose a route which crosses the hills and valleys of the Plains instead of following a single valley, he will see for himself this relation of the trees to the general surface of the country, and he may even see evidence of the westward march of the trees, where the fires no longer check their growth. With the increase in elevation the fringes of trees along the streams grow narrower and narrower, until at last they disappear altogether on the high plains at the foot of the mountains, 4,500 feet or more above the sea. This is the land of the 'sage brush,' 'dagger weed,' 'buffalo grass,' 'bunch grass' and 'cactus.' It is not a desert, and yet is as uninviting as one—until man runs little streams of water over it, when as if by magic it is transformed into a garden of flowers and fruits, or a farm of golden wheat and purple alfalfa. What water is to the plant is nowhere better shown than on these high Colorado plains, a mile above the sea. Then, still beyond, are the mountains, with a vegetation entirely unlike that of the plains at their base. Pines, spruces, firs, cedars are all of different species from those of the east, and not many of the deciduous trees are of species which are common along our Atlantic border. For the botanist who sees this flora for the first time it will be a novel experience to find that he can name scarcely a plant that he sees, whether herb, shrub or tree. He will need his collecting case and plant press, as it will be impossible for him to resist the desire to make specimens of the many interesting plants he finds at every turn.

THE SAND HILLS OF NEBRASKA.

The interesting region known as the Sand Hills of Nebraska may be visited by the botanists who attend the Denver meeting in August. They occupy an area of from 15,000 to 20,000 square miles in central and northern Nebraska, having a width of from 100 to 200 miles. The prevailing contour of the surface is irregular, consisting of rounded, swelling hills with gentle depressions between them, or elongated ridges with steep sides, enclosing deep valleys. These hills consist of sand or gravel, and when the surface vegetation is removed the sand is driven by the winds, and forms moving dunes. To a very large extent the surface configuration is such that the water which falls in the rains is not drained off in streams, but disappears in the porous soil or evaporates from the surface. Here and there are streams which find their way through the valleys and hills, and where these streams are of considerable size they have worn deep canyons. Such streams are always fed by many springs which burst out from the sides of the canyons, and doubtless in this way the water which falls upon the areas which have no surface drainage finds its exit.

The vegetation in the Sand Hills consists almost entirely of grasses and sedges intermingled with deep-rooted perennial herbaceous or woody plants. The perennial herbaceous plants are coarse, strong-growing species, and the woody plants are to a very large extent of low stature and with large, widely-spreading roots. Among these shrubs are the sand cherry (*Prunus besseyi*), shoe string (*Amorpha canescens*), one or more species of prairie clover (*Kuhnistera*), one or two species of wild roses (*Rosa arkansana* and *Rosa woodsii*), New Jersey tea (*Ceanothus ovatus*),

etc. In the wet valleys occur wild plums (*Prunus americana*), and the dwarf wild cherry (*Prunus demissa*), the former a shrub or small tree, and the latter an upright little-branched shrub, both usually forming close thickets.

The trees are almost entirely confined to the narrow belts which border the streams in the canyons. Where the canyons are deep these forest belts are entirely hidden as one glances over the undulating surface of the plain. In the eastern part of the Sand Hill region the forest belts are wider, but in passing westward they are narrower, the trees are lower, and eventually they are mere straggling shrubs, finally disappearing altogether. The species are to a large extent those found in the eastern portion of the State, there being but few cases in which the Rocky Mountain trees have taken possession of such protected areas. They are the white elm, occasionally the red elm, the box elder, red ash in small numbers, green ash in larger numbers, sometimes the hackberry, with the common cottonwood and several species of willows, and occasional hawthorns, with here and there the remnants of groves of bull pine (*Pinus scopulorum*).

THE GRASSY COVERING OF THE GREAT PLAINS.

THOSE who visit the Great Plains for the first time are usually interested in the grassy covering, which is the most marked feature of the vegetation of the region. This covering is mostly composed of a mixture of several species, there being few places where a single species occupies the ground to the complete exclusion of all others. In the eastern portion of the region the grassy plants (including sedges) number about 130 species, in the central portion (the Sand Hills) there are 170 species, while in the western portion (the Foot Hills) there are about 110 species. The eastern visitor will notice with interest the 'buffalo grass' (*Bulbilis dactyloides*) in well-marked patches, the different species of 'grama' (*Bouteloua oligostachya*, *B. hirsuta*, and *B. curtipendula*) scattered over the surface, the 'wheat grasses' (*Agropyron pseudorepens* and other species) usually mingled with species of *Bouteloua*, the 'bunch grasses' (*Andropogon scoparius*, *A. furcatus* and *A. hallii*) scattered in bunches over the surface, the 'needle grasses' (*Stipa spartea*, *S. comata* and *S. viridula*) scattered in bunches over the surface, with other species known in general as 'prairie grasses' (species of *Kœleria*, *Eatonia*, *Sporobolus*, etc.). Should he go into the Sand Hills he would find the 'blowout grasses' (*Muhlenbergia pungens*, *Eragrostis trichodes*, *Oryzopsis cuspidata* and *Redfieldia flexuosa*) in or on the margins of the naked sand pits blown out of the hillsides. In the Foot Hills he would find great areas covered almost exclusively with the yellowish-brown foliage of the little sedge (*Carex filifolia*) known throughout the region under the names 'nigger wool,' 'nigger root,' or 'black root,' highly esteemed by the stockmen for its nutritious qualities, and whose tough and durable black roots form a persistent sod much used by the settlers in the construction of their 'sod houses.'

TREES OF THE RYDBERG COTTONWOOD.

IT may be of interest to some of the botanists who will visit the Rocky Mountains this summer to know that they can see many fine specimens of the 'Rydberg cottonwood' (*Populus acuminata*) in the town of Colorado Springs. They have been planted along the streets and avenues mingled with trees of the common cottonwood (*Populus deltoidea*). Especially fine trees may be seen along the east side of Cascade avenue. Botanists will remember that in 1893 this tree was first described by Dr. Rydberg in the *Bulletin of the Torrey Botanical Club* (February, 1893) from material collected in the canyons of the Wildcat Mountains of Western Nebraska. Since the publication of the species it has been found to extend from the Black Hills southward to Southern Colorado, New Mexico and Arizona. In the plantings along the streets of Colorado Springs this species was not distinguished from the common cottonwood. The two trees may, however, be very easily distinguished by the shape and particular contour of the leaves, which are rhomboid-lanceolate with serrulate margins in the new species, in contrast to the broadly deltoid-ovate leaves of the common species with their incurved-dentate margins.

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THE UNIVERSITY OF NEBRASKA.

THE AMERICAN FORESTRY ASSOCIATION.

THE principal summer meeting of the American Forestry Association for 1901 will be held at Denver, Colorado, Tuesday, Wednesday and Thursday, August 27–29, in affiliation with the American Association for the Advancement of Science, as we learn from the *Forester*, the official journal of the Association.

There will be two sessions daily, at 10 a. m. and 2:30 p. m., which will be held in the Denver High School building, and, in addition, an open evening meeting, in the Central Presbyterian Church, Wednesday, August 28, at 8 p. m. At the latter meeting there will be short addresses by Hon. Thomas M. Patterson, Hon. Thomas F. Walsh, Hon. Platt Rogers, and others, followed by an illustrated lecture by Mr. Gifford Pinchot, Forester of the United States Department of Agriculture, entitled 'The Government and the Forest Reserves.' This meeting will be a distinctively Western one, and its proceedings of special interest to all concerned with the forest problems before the Western States—fires, grazing, relation of forests to water supply, etc.

The address of welcome at the opening session, Tuesday, August 27, 10:30 a. m., will be delivered by Hon. Thomas M. Patterson, United States Senate. It is expected that the President of the Association, Hon. James Wilson, Secretary of Agriculture, will attend the meeting, and preside at one or more sessions.

A partial list of speakers at the meeting, and their subjects, follows:

Mr. A. L. Fellows, Denver, Col., 'The Hydrography of Colorado'; Mr. Geo. B. Sudworth, Chief of Division of Forest Investigation, Bureau of Forestry, Washington, D. C., 'Forests and their Relation to Agriculture and Manufacturing Industries'; Mr. S. J. Holsinger, Phœnix, Arizona, 'The Boundary Line between the Forest and the Desert'; Professor R. H. Forbes, Tucson, Arizona, 'The Open Range and the Irrigation Farmer'; Mr. R. L. Fulton, Reno, Nevada, 'The Reclamation of the Arid Region'; Mr. William L. Hall, Superintendent of Tree Planting, Bureau of Forestry, Washington, D. C., 'Progress in Tree Planting'; Professor A. J. McClatchie, Phœnix, Arizona, 'The Eucalypts as American Forest Trees'; Mr. T. P. Lukens, Pasadena, California, 'The Reforestration of Watersheds'; Professor L. H. Pammel, Ames, Iowa, 'Some Phases of the Growth of the Cultivated Trees in Iowa'; Mr. F. H. Newell, Hydrographer, U. S. Geological Survey, Washington, D. C., 'Forests as Reservoirs'; Mr. Gifford Pinchot, Forester, Washington D. C., 'Grazing in the Forest Reserves.' Other speakers are: Professor William R. Dudley, Stanford University, California; Mr. William H. Knight, Los Angeles, California; Mr. George H. Maxwell, Chicago; Edward M. Griffith, Bureau of Forestry, Washington, D. C.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FOR the benefit of members who will attend the Denver meeting of the Association beginning on August 24, we reproduce the arrangements made with the railways:

The Western Passenger Association, covering the territory *west* of Chicago and St. Louis, has made a rate of one fare plus $2 for the round trip, from all points in their territory to Denver, tickets to be sold July 10 to August 31, with final return limit of October 31.

The New England, Trunk Line, Central and Southeastern Passenger Associations, covering the territory *east* of Chicago and St. Louis, have made a rate of a fare and one-third for the round trip from all points in their territory to Denver, on the certificate plan, the conditions of which are as follows:

1. Each person desiring to avail himself of the reduced rate must purchase a first class ticket (either limited or unlimited) to the place of meeting, at the regular tariff rate and at the same time procure from the ticket agent a certificate of the standard form. If through ticket cannot be procured at the starting point, the person should purchase to the most convenient point at which such ticket can be obtained and there repurchase through to the place of meeting, *procuring a standard certificate from each agent from whom a ticket is purchased.*

2. *It is absolutely necessary that certificates be procured, indicating that the full fare has been paid for going passage and the route for which*

ticket or tickets for the return journey should be sold. No refund of fare can be expected because of failure to secure such certificates.

3. Tickets for the return journey will be sold at one-third the first-class tariff fare only to persons holding certificates of the standard form duly signed by the Permanent Secretary of the A. A. A. S., and signed by the special agent appointed for that purpose.

4. No certificate will be honored that was procured more than three days (Sunday not included) before the meeting assembles (except that when meetings are held at distant points to which the authorized transit limit is more than three days, the authorized transit limit will govern), nor more than two days (Sunday not included) after the first day of the meeting. No certificate will be honored for return ticket unless presented during the time that the meeting is in session, or within three days (Sunday not included) after adjournment.

5. Tickets for return journey will be limited to continuous passage on first train after purchase.

6. Certificates will not be honored by conductors; they must be presented to ticket agents.

7. Neither the certificates nor tickets furnished for this occasion are transferable, and if presented by any other person than the original purchaser, they will not be honored but will be forfeited.

Members desiring longer time than that allowed in connection with certificate reduction, viz., 3 days before the meeting assembles to 3 days after adjournment (Sunday not included), are advised to take advantage of the Colorado tourist fares or summer excursions, which, while costing a little more than the fare and one third, are good from July 10 to October 31.

If a sufficient number of passengers can be guaranteed, arrangements can be made for through Pullman service, to connect at Chicago or St. Louis, so that members from different sections of the country can make the trip to Denver together. The Permanent Secretary therefore invites all members who plan to attend the meeting and who wish to take advantage of this through Pullman service to communicate with him at once, stating the name of the road over which they intend to travel and the date of their departure. If a sufficient number of replies are received, the arrangement will be made and members notified.

SCIENTIFIC NOTES AND NEWS.

THE Smithsonian Institution, having provisionally undertaken to represent the 'International Catalogue of Scientific Literature' in the United States, begs to bring this fact to the attention of men of science in the United States, and to request them to furnish the Institution with copies of all their writings which appear in separate form. It is intended to index all original scientific matter published since January 1, 1901.

THE position of State Geologist of New Jersey, vacant by the resignation of Mr. John P. Smock, has been offered to Professor I. C. Russell, of the University of Michigan. Professor Russell agreed to accept the office a year hence, and the board of managers has not yet decided whether to wait. In the meanwhile Dr. H. B. Kümmel is acting geologist.

PROFESSOR H. C. BEELER has been appointed state geologist of Wyoming.

PROFESSOR GEORGE E. HALE, director of the Yerkes Observatory, has been elected a foreign member of the Società degli Spettroscopisti Italiani.

THE Paris Academy of Sciences has elected M. Maupas, of Algiers, a corresponding member in the section of anatomy and zoology.

WE learn from *Nature* that Professor A. W. Rücker will resign the secretaryship of the Royal Society in consequence of his appointment as principal of the University of London.

PROFESSOR PASQUALE VILLERI has been elected president of the Reale Accademia dei Lincei, of Rome.

PROFESSOR E. B. POULTON, of Oxford University, will give one of the lectures at the Fifth International Congress of Zoology which meets next week at Berlin. His subject is 'Mimicry and Natural Selection.'

PROFESSOR WILLIAM B. SCOTT, of Princeton University, has arrived in La Plata, Argentina,

on his way to Patagonia where he will continue the paleontological studies that have been carried forward by several Princeton expeditions.

Professor Osborn, accompanied by Professor Eberhard Fraas, of Stuttgart, has recently made a tour of the chief typical Jurassic exposures of Colorado, Utah and Wyoming, especially the beds of Cañon City, Green River, Como and the Black Hills. This is preliminary to a careful survey of these beds, which will be made for the monograph upon the Sauropoda. Valuable geological studies of the Jurassic have recently been published by Knight, Logan and especially by Loomis. Professor Fraas is very familiar with the Jurassic of Europe, having personally studied all the Jurassic exposures, and as a result of this trip he will undertake a careful correlation of the American and European Jurassic horizons which will be published by the American Museum. Messrs. Wieland and Loomis are also independently studying the Jurassic sections in the Black Hills region.

President David Starr Jordan has returned from the expedition to the Hawaiian Islands, sent by the U. S. Fish Commission.

Dr. Theodore Gill, of the Smithsonian Institution, has just returned from a European trip during which he enjoyed opportunities of examining ichthyological and other collections in various museums, and thus of materially advancing his comparative studies.

Dr. Henry S. Pritchett, superintendent of awards at the Pan-American Exposition, has announced as jurors in the department of electrical exhibits: Carl Hering, chairman; F. B. Crocker, A. V. Abbott, D. C. Jackson, W. S. Franklin, W. S. Barstow, W. E. Goldsborough, A. E. Kennelly, Henry S. Carhart and William L. Puffer.

Chief Officer Hans Russer, of the Baltimore and Hamburg liner *Batayia*, has been appointed captain of the German Antarctic expedition.

Sir Norman Lockyer, having reached the age of sixty-five years, will at the end of the present year give up his duties as professor of astronomical physics in the Royal College of Science, London.

Judge Addison G. Brown, of the United States District Court for the Southern District of New York, having served twenty years and having reached the age of 72 years, has resigned. Judge Brown is known among scientific men as a botanist. He was long president of the Torrey Botanical Club, and cooperated with Professor N. L. Britton in the publication of the illustrated 'Flora of the Northern United States and Canada.'

Members of the Indiana Forest Board, established at the recent session of the Legislature, have been appointed by Governor Durbin as follows: Professor William H. Freeman, of Wabash, secretary of the board; Professor Stanley S. Coulter, Purdue University, Lafayette; Finlay P. Carson, Michigan City, repreing the Indiana Retail Lumber Dealers' Association; John Cochrane, Indianapolis, representing practical woodworkers; Albert Lieber, Indianapolis, representing the Indiana Forestry Association.

The Executive Committee of the National Physical Laboratory of Great Britain have made the following appointments: *Superintendent of the Engineering Department:* T. E. Stanton, D.Sc., Victoria; *Assistants in the Physics Department:* J. A. Harker, D.Sc., Victoria; A. Campbell, B.A., Cambridge; H. C. H. Carpenter, M.A., Oxon., Ph.D., Leipzig; *Junior Assistants:* B. F. E. Keeling, B.A., Cambridge; F. E. Smith, Royal College of Science. It is expected that one or two more junior assistants will be appointed shortly. The London *Times* states that the alterations to Busheyhouse and the new buildings for the engineering laboratory are well advanced, and it is hoped to begin work early in October. Of the staff, Dr. Stanton, after serving an apprenticeship with an engineering firm in the Midlands, has had a distinguished career at Manchester and Liverpool, and is now professor of engineering at University College, Bristol. His paper on 'Surface Condensors,' published in the *Philosophical Transactions*, is well known to engineers. Dr. Harker and Mr. Campbell have both done work of real value in thermometry and electric measurements; while Dr. Carpenter, who will have charge of the chem-

cal researches, after a successful course at Oxford, has gained further experience at Leipzig under Ostwald, and more recently at Owens College. Mr. Keeling obtained a double first in natural science and mechanical science respectively at Cambridge; while Mr. Smith was the most distinguished student of his year at South Kensington, and for two years has been one of Professor Rücker's assistants.

DR. CHARLES T. MOHR, the well-known botanist, died at Asheville, N. C., on July 17. He had been a resident of Mobile, Ala., for a number of years, but about a year ago moved to Asheville, N. C.

THE western press announces the death of Dr. Joshua Miller, of Arizona. Dr. Miller was an enthusiastic student of the archeology of the Territory, and was instrumental in creating the Arizona Antiquarian Association, of which he was made president; he was also instrumental in securing the enactment of a law for the protection of the antiquities of the territory from ruthless destruction.

GEORGE K. LAWTON, of the U. S. Naval Observatory, died at Washington on July 25.

THE death is announced of Felix Joseph Henri Lacaze-Duthiers, the eminent French naturalist. Born in 1821, he began the study of medicine, but soon turned to zoology, and was appointed professor at Lille at the age of thirty-three years. In 1865 he became professor of zoology at the Paris Museum of Natural History, and three years later he was appointed to a similar position in the faculty of sciences. He was elected a member of the Academy of Sciences in 1871. In 1875 he established a zoological laboratory on the coast of Brittany.

M. JOSEPH HIRSCH, professor at the Paris Conservatoire des arts et métiers and inspector of bridges and highways, has died at the age of sixty-five years.

DR. W. SCHUR, professor of astronomy and director of the observatory at the University of Göttingen, died on July 1, aged fifty-five years.

WE also regret to record the death of Dr. Antonio Piccone, professor of botany at Genoa, and Dr. Otto Wiedeburg, professor of physics in the Institute of Technology at Hanover.

ON August 31, there will be a civil service examination for the position of instrument-maker, Coast and Geodetic Survey, at a salary of $1,000. On September 3, there will be an examination for the position of computer in the Survey at the same salary.

MR. ANDREW CARNEGIE has presented the city of Winnipeg with $100,000 for a free public library. The gift has been accepted by the City Council. Mr. Carnegie has also offered $50,000 to build a library at St. Johns, Newfoundland.

WE learn from the *Astronomical Journal* that the government of the Republic of Ecuador has placed the Observatory of Quito at the disposal of the French Commission charged with the remeasurement of the Peruvian arc. M. Gonnessiat, astronomer of the Observatory of Lyons, has been entrusted with the direction of the establishment. The new director has taken possession of his post, and is actively engaged in organizing astronomical, meteorological and magnetic services.

THE Guttenberg Museum at Mayence was opened on June 23.

TWO further tracts of land, together somewhat less than an acre in extent, have been purchased for the U. S. Naval Observatory at a cost of $6,000.

Nature states that the biological station which had been kept on Lake Baikal for a year by the East Siberian Geographical Society, at Goloustnaya, on the west coast, has been closed. A rich collection of fishes, especially of *Cottus* species, and a great variety of *Gammarus* species have, however, been secured, and the latter are in the hands of Professor Sars, of Christiania.

PROFESSOR TODD'S eclipse expedition to Singkep, an island of the Netherlands Indies, secured 28 photographs of the corona on May 18, partly through clouds. Mr. Percy Wilson, of the New York Botanical Garden, who went out as collector of the expedition, has obtained many valuable exhibits and living plants, among them numerous orchids. Mr. Wilson is

now in Java, making further collections in Buitenzorg, and will return home in August.

The daily papers say that Dr. A. H. Doty, health officer of the port of New York, proposes to try to exterminate the mosquitoes of Staten Island. Men are said to be at work mapping all the marshes, stagnant pools, etc., and crude petroleum is to be released beneath the surface of the water. The marshes, etc., will also be drained.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. A. C. Bartlett has increased his gift for a gymnasium for the University of Chicago from $125,000 to $200,000.

Mr. John S. Newbury, of Detroit, has given Yale University $25,000 for an organ, to be placed in Memorial Hall.

A new astronomical observatory with increased equipment, including the equatorial telescope which formerly belonged to the late Judge Knapp of New Jersey, is being erected at Lincoln University, Pa. This will be used mainly for purposes of instruction under the directorship of Professor Walter L. Wright, Jr. who has, for a number of years, been in charge of the department of mathematics at that institution.

The General Purposes Committee of the Birmingham City Council has decided to recommend a grant of the proceeds of a half-penny rate which will provide the University with the sum of £5,000 annually.

Four members of the faculty of the Connecticut Agricultural College, Storrs, Conn., have been asked to resign, as a result, it is said; of their alleged opposition to the policy of President Flint. They are: Nelson S. Mayo, M.S., D.V.M., professor of anatomy, physiology and veterinary science; Henry A. Ballou, assistant professor of forestry, botany and military science; Thomas D. Knowles, instructor in English, mathematics, history and physical culture; Charles E. Myers, instructor in farm accounts and business methods, and secretary of the faculty.

We learn from *The Botanical Gazette* that the regents of the University of West Virginia have abolished the professorship in botany without notice to the present incumbent, Dr. E. B. Copeland. Dr. Copeland is spending the summer at the Cold Spring Biological Laboratory.

The chair of pathology in the University of Sydney is vacant and applications for it are invited. The salary is £900 per annum and a pension of £400 per annum is allowed on certain conditions after twenty years' service. The sum of £100 will be allowed for passage expenses from Europe or America. The successful applicant is to begin his duties on March 1, 1902. Further particulars may be obtained from the Agent-General for New South Wales, 9 Victoria Street, London, S. W., to whom applications, stating applicant's age (which must not be more than forty years) and qualifications, and accompanied by four copies of each testimonial submitted, should be sent not later than September 14, 1901.

At the July meeting of the Board of Regents, Mr. L. W. Hartman was elected to the professorship in physics at the Kansas State Agricultural College for the coming year. For the past year and a half Mr. Hartman has been on the staff of the department of physics at Cornell University.

Karl Wilhelm Genthe, Ph.D. (Leipzig), has been appointed instructor in natural history in Trinity College.

The following have been appointed assistants in histology and embryology at Cornell University: Arthur M. Bean, A.B., of Iowa College; Charles W. Bunker, B.S., of the University of Nebraska; Bert R. Hoobler, B.S., of Wabash College; William C. Thro, A.M., of Cornell University; Gersham F. White, B.S., of Ohio University, and William F. Wismar, A.B., of Rochester University.

Dr. Alfred Koch, of Oppenheim, has been appointed associate professor and director of the Institute of Agricultural Bacteriology at the University of Göttingen.

Dr. Edmund Landau has qualified as docent in mathematics at the University of Berlin, and Dr. G. Senn as docent in botany in the University of Basle.